OVER 350,000 COPIES OF THIS ISSUE

RADIO NEWS

REG. U.S. PAT. OFF.

DECEMBER
25 Cents

Over 200 Illustrations

BROADCAST WRNY STATION

Edited by HUGO GERNSBACK

Radio phonograph short wave

HOW TO MAKE THE LOUD-SPEAKING X-MAS TREE

See Page 632

In this Issue— "THE NEW HAMMARLUND-ROBERTS CIRCUIT"

EXPERIMENTER PUBLISHING COMPANY, NEW YORK, PUBLISHERS OF
SCIENCE & INVENTION★RADIO REVIEW★AMAZING STORIES
MONEY MAKING★RADIO INTERNACIONAL

Cunningham RADIO TUBES

Since 1915—Standard for All Sets

Cunningham
Radio Tubes
are astoundingly good all
the year 'round and at Christmas
time you will receive even a greater
appreciation of their quality perfor-
mance because of the attractive Yule-
tide programs. These radio programs
come in clear and full-toned when
your receiving set is Cunningham
equipped. ¶ Every broadcast station
splurges a bit at Christmas time and
gives you something extra good. ¶ Entertainers
are stimulated to do their best by the knowledge
that thousands of new sets are tuned in and that
their already large and enthusiastic audience has
swelled to even larger proportions during this Christ-
mas and holiday time. ¶ Radio sets and radio equip-
ment in general make immensely popular Christmas
gifts. ¶ Why not increase someone's pleasure a thousand
fold by the gift of a radio set this Christmas? ¶ If you want
to make this lucky person's happiness complete, you will make
sure that the set has a Cunningham Radio Tube in every socket.
¶ To bring increased happiness to someone who now owns a receiver,
give him a set of Cunningham Radio Tubes, known since 1915
as standard for all sets.

A. J. Cunningham Inc.

NEW YORK
CHICAGO
SAN FRAN-
CISCO

Tower

Meistersinger CONE

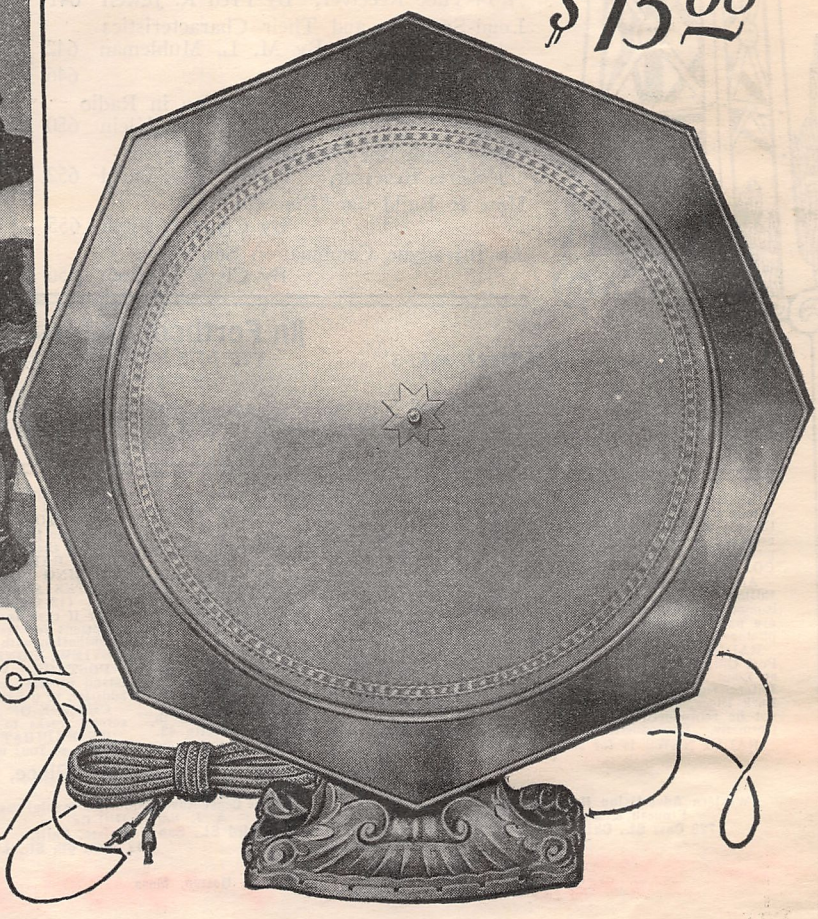
TOWER has built a new cone — the Meistersinger — a radio speaker of dignified beauty matched only by its rare tonal capabilities. Ideal for power tube operation, the new Meistersinger can also be used as a Wall Model by detaching base. The exclusive driving mechanism and free edge cone, 16″ in diameter, is protected by a solid mahogany frame and metal base with dolphin motif.

Such quality heralds the Meistersinger as a value without precedent among cone speakers—a most appropriate Christmas gift.

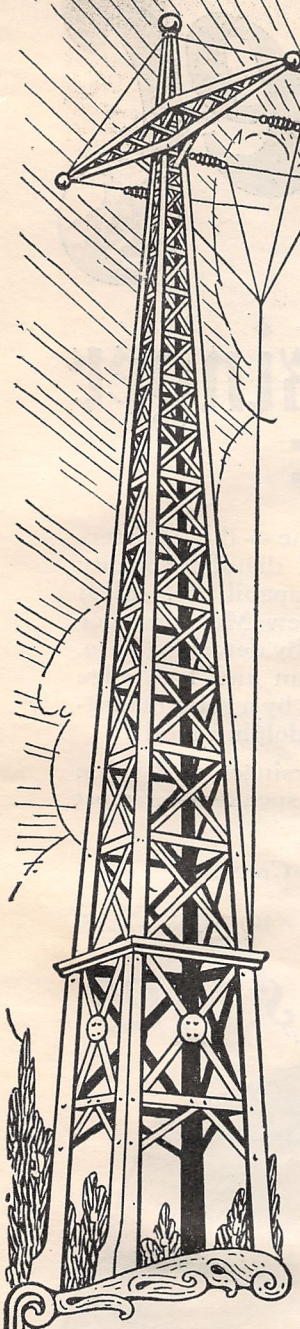
On Sale from Coast to Coast.

TOWER MFG. CORP., BOSTON, MASS.

$15.00



Merry Christmas



RADIO NEWS

Published by EXPERIMENTER PUBLISHING COMPANY, Inc., Publishers of "Radio News," "Science and Invention," "Radio Internacional," "Radio Review," "Money Making" and "Amazing Stories."
Editorial and General Offices: 53 Park Pl., New York City
H. GERNSBACK, President. S. GERNSBACK, Treasurer. R. W. DEMOTT, Secretary.
Member: Audit Bureau of Circulations Radio Magazine Publishers Association

VOLUME 8 DECEMBER, 1926 NUMBER 6

Contents of This Issue:

Edison and Radio, By Hugo Gernsback 625
New Television Apparatus, By Lucien Fournier 626
Radio News of the Month 628
List of Broadcast Stations in the United States 629
Electrifying Your Phonograph, By H. B. Whiffen 630
The Loud-Speaking Christmas Tree, By Hugo Gernsback 632
Advancement in Radio, Illustrated 633
The Place of Radio in Home Decoration, By Golda M. Goldman 634
Speaking Over the Radio, By Charles D. Isaacson 636
Radio For All Ages 637
A Christmas Gift of Happiness 638
Recent Topics of Radio Interest Illustrated, By George Wall 639
Radio in the Railroad Yards, By S. R. Winters 640
A 14-Tube Receiver, By Fred R. Jewell 641
Loud-Speakers and Their Characteristics By M. L. Muhleman 642
What's New in Radio 646
The Neutrodyne and Its Position in Radio By R. M. Klein 650
Constructing the Shielded Hammarlund-Roberts Receiver, By V. T. Baird 652
How to Build the "Pianorad," By Clyde J. Fitch 655
An Infradyne Combination Set, By Clyde J. Fitch 656
An Improved "Bass Note" Circuit, By George V. Rockey 658
Home-Made Coils for the Browning-Drake and Similar Circuits, By C. A. Oldroyd 660
A Versatile Superheterodyne, By Leslie Raymond Jones 662
A Universal All-Circuit Set, By Joseph Riley 664
Establishing Radio Standards of Frequency, By C. B. Jolliffe and Grace Hazen 666
Magnetic Fields in Vacuum Tubes, By Robert Serrell 668
"Design Engineering" in Radio Apparatus, By E. T. Flewelling 669
The Acoustat, By O. C. Roos 670
Progress in Radio 672
Correspondence from Readers 673
Radiotics 674
Radio Wrinkles 675
RADIO NEWS LABORATORIES 676
Short-Wave Receiver Adjustment and Operation, By A. Binneweg, Jr., 6BX-6XAA 678
I Want to Know, By Joseph Bernsley 679
QRA's 688
What Chemistry Has Given to Radio, By O. Ivan Lee 700
Wired Radio in England, 722
The Main Problems of Television, By Dr. Walter Friedel 767
Government and the Radio, By Bella Webb 770
Radio Reception With Two Grounds, By H. A. Everest 771

In Forthcoming Issues:

BROADCASTING WEATHER MAPS BY RADIO
By S. R. Winters and B. F. Dashiell
The newest use to which Radio is being put by government scientists.

VISIBLE RADIO WAVES
By Clyde J. Fitch
An interesting suggestion of the possibilities to which radio may be put for aviation, as well as pure research.

A NEW SUPERHETERODYNE,
By R. E. Lacault
The inventor of the Ultradyne presents an article which will make easy for RADIO NEWS readers the construction of a receiver of great power and fine quality.

RADIO NEWS is published on the 10th of each preceding month. There are 12 numbers per year. Subscription price is $2.50 a year in U. S. and possessions. Canada and foreign countries, $3.00 a year. U. S. Coin as well as U. S. Stamps accepted (no foreign coins or stamps). Single copies, 25 cents each. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., INC.

All communications and contributions to this journal should be addressed to Editor, RADIO NEWS, 53 Park Place, New York, N. Y. Unaccepted contributions cannot be returned unless full postage has been included. All accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

RADIO NEWS. Monthly. Entered as second class matter, July 12, 1924, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Additional entry at Long Island City, N. Y. and San Francisco, Calif. Title registered U. S. Patent Office. Copyright, 1926, by The Experimenter Publishing Co., Inc., 53 Park Place, New York. The Contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication. Copyrighted in Germany. Reproduction of articles in Germany is reserved for Radio, Berlin 42.

RADIO NEWS is for sale at all newsstands in the United States and Canada, and at Brentano's, Ave de L'Opera, Paris, France. European agents: S. J. Wise Et Cie, 40 Place Verte, Antwerp, Belgium.

HOW TO SUBSCRIBE FOR RADIO NEWS. Send your name, address and remittance to Experimenter Publishing Co., 53 Park Place, New York. Mention the name of the magazine you are ordering. We also publish SCIENCE AND INVENTION, RADIO INTERNACIONAL, RADIO REVIEW, MONEY MAKING and AMAZING STORIES. Write clearly.

RATES AND TERMS. The subscription rate for RADIO NEWS is $2.50 per year. (12 numbers). When remitting do so by check, money order, or registered letter if cash is enclosed. Avoid sending cash through the mail if possible. Subscriptions for less than one year are not accepted. Subscription may be made in combination with SCIENCE & INVENTION, RADIO INTERNACIONAL, RADIO REVIEW, MONEY MAKING and AMAZING STORIES.

POSTAGE. We prepay postage in all parts of the United States, Mexico and island possessions. For foreign or Canadian subscriptions we require 50 cents in addition to the subscription price for additional postage charges.

CHANGE OF ADDRESS. Notify us as far in advance as possible. It requires several weeks to make an address change on our records. Always write clearly.

ON EXPIRATION of your subscription we enclose a renewal blank in our last number to you; we stop our delivery to you on expiration.

General Advertising Dept., 53 Park Place, New York City.

Western Advertising Representatives
Finucan & McClure
720 Cass St., Chicago, Ill.

Pacific Coast Advertising Representatives
A. J. Norris Hill Co.
5 Third St., San Francisco, Calif.
412 West 6th St., Los Angeles, Calif.

Kansas City Advertising Representatives
Davies and Dillon
15 W. Tenth St., Kansas City, Mo.

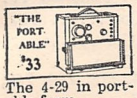
New England Advertising Representative
T. F. Magrane, Park Square Building, Boston, Mass.

Detroit Advertising Representative
Roy Buell, Donovan Bldg., Detroit, Mich.

CROSLEY RADIO
All prices slightly higher west of Rocky Mts.

This little double-circuit 1-tube set has made long distance records.

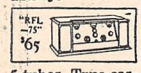
4 tubes. Amazing efficiency, Crescendon equipped!



The 4-29 in portable form.

Five tubes, tuned radio frequency. Two stages non-oscillating radio frequency amplification, Crescendon, two stages audio frequency amplification.

5 tubes, 1-dial control acuminators, Crescendon, power tube adaptability.



5 tubes. True-cascade amplification; non-oscillating and non-radiating.

In a mahogany console. 5-tube 5-50 receiver, Crosley Musicone speaker, ample compartment for batteries.

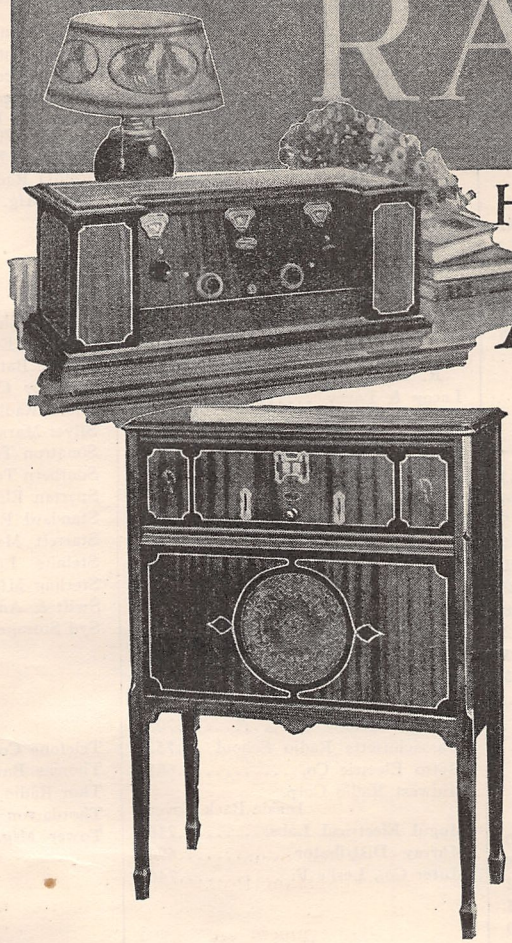
Double drum station selector! Musicone and room for batteries and accessories.

12-inch size, $12.50. Super Musicone, $14.75. Musicone Deluxe, $23.50. Also beautiful Musiconsole with room for batteries and accessories, as below.

CROSLEY

BETTER ... COSTS LESS

RADIO



Highly Selective

R.F.L. models

Manufactured under Radio Frequency Laboratory License

Crosley R. F. L. sets represent the highest known development in radio receivers. They will not howl, squeal or re-radiate while tuning—no matter how inexperienced the operator may be.

They are sensitive to a degree rarely attained in tuned radio frequency circuits, cutting out nearby stations with an ease and simplicity that makes them ideal for use in congested broadcasting areas.

Persons technically initiated will instantly understand the perfection of Crosley R. F. L. sets when they realize that true cascade amplification, in addition to absolute balance, is accomplished through the use of Wheatstone bridges in each stage of radio frequency.

To this technical perfection Powel Crosley, Jr. has applied his mass production methods, with the result that nowhere else will the radio buyer find equipment that even approaches Crosley values.

The use of parts in million quantity lots, the simplification of mechanical processes and assembly, and the ownership of wood-working factories which produce exquisite mahogany cabinets at an almost unbelievable low cost, are the means employed by Crosley to make possible the highest type of radio reception at the lowest possible price.

That the public is appreciative of the excellence of Crosley R.F.L. radio sets, as well as the opportunity to enjoy them at small cost, is daily indicated by the tremendous volume of Crosley sales.

Table Model R.F.L.—75

Beautiful two-tone mahogany cabinet—High ratio vernier controlled condensers affording sharp tuning—Recessed dials behind windows—Rich metal trimmings—Power tube adaptability. Appearance and efficiency of this set are out of all proportion to its low cost—the result of Crosley mass production.

$65

6-Tube Console Model R.F.L.—90

Double drum station selector. Mahogany console finished in two tones. Crosley Musicone built-in. Ample space for all batteries and accessories. Power tube adaptability. Comparable in appearance to the highest priced radios, and in performance it has few equals.

$90

THE CROSLEY RADIO CORPORATION, CINCINNATI—POWEL CROSLEY, Jr., President

Crosley manufactures radio receiving sets, which are licensed under Armstrong U. S. Patent No. 1,113,149 or under patent applications of Radio Frequency Laboratories, Inc., and other patents issued and pending. Owning and operating station WLW, first remote control super-power station in America. All prices without accessories.

For Catalogue write Dept. 22

Crosley Features

"CRESCENDON"

When, on ordinary radios, ears must strain to catch a station miles away, a turn of the Crescendon on Crosley radios instantly swells reception to room-filling volume. An exclusive Crosley feature.

ALL-METAL SHIELDED CHASSIS

This truly great radio achievement, found in several Crosley sets, furnishes a substantial frame for mounting elements, produces excellent alignment of condensers, shields the units from each other, prevents interstage, improves the stability of the circuit, increases selectivity and saves costs by standardizing this phase of manufacture.

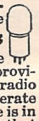
THE SINGLE-DIAL STATION SELECTOR

Nothing in radio equals the joy or the convenience of single dial control. Crosley single drum control enables you to find the stations sought without log book or "tuning"

"THE ACUMINATORS"

Crosley Acuminators permit tuning in—loud and clear—weak stations passed over and entirely missed by ordinary single dial radios. In tuning high powered and local stations they are not used.

USE OF POWER TUBE



Power tube adaptability marks the Crosley "5-50", "5-75" and "RFL" sets. This feature typifies Crosley provision for best radio reception at moderate cost. This feature is in keeping with all that is most progressive.

HEAD PHONES
$3.00

QUALITY AND BEAUTY IN CABINETS AND CONSOLES

INDEX TO ADVERTISERS

INDEX TO ADVERTISERS

Page

A

Acme Apparatus Co. 689
Acme Electric & Mfg. Co., The 746
Advance Electric Co. 752
Aero Products, Inc.... 692
Aerovox Wireless Corp. 710
Alden Mfg. Co. 705, 706, 708, 710, 712
All-American Radio Corp. 699
All Radio Co. 768
Allen-Bradley Co. 690, 720, 747, 750, 756
Ambu Radio Institute 769
American Auto & Radio Mfg. Co., Inc. 712-762
American Battery Co. 718
American Bosch Magneto Corp. 697-732
American Electric Co. 700
American Hard Rubber Co. 702, 708
Amplion Corp. of America, The 710
Amrad Corp., The 731
Amsco Products, Inc. 763
AutoStrop Safety Razor Co. 755

B

Baker Yacht Basin, Inc., The ..736
Barawik Co., The 730, 740, 742, 744, 746, 748, 752, 761, 763, 764, 769, 779, 773
Belden Mfg. Co. 753
Benjamin Electric Mfg. Co. ...749
Birnbach Radio Co. 770
Bodine Electric Co. 694
Bogue, B. N. 712
Bolton Co., Arthur 714
Boudette Mfg. Co. 724
Bradley Institute 716
Brady, John B. 706
Bremer-Tully Mfg. Co 621
Brush Pottery Co. 767
Buckingham Radio Corp. 769

C

C. E. Mfg. Co. 754
Carborundum Co., The 737
Carlton Mills, Inc. 730
Carter Radio Co. 728
Central Radio Labs 692
Chaslyn Co., The 726
Chelsea Radio Co. 756
Chemical Institute of N. Y., Inc. 766
Chicago Radio Apparatus 720
Chicago Salvage Stock Stores ..690
Chicago Stock Gear Works 763
Clark & Tilson, Inc. 740
Consrad Co., Inc. 764-775
Cooper Corp., The 707
Cornell Electric Mfg. Corp. 702
Cornish Wire Co. 742
Coyne Electrical Schools 770
Crescent Radio Supply Co. 763
Crosley Radio Corp., The 619
Culver-Stearns Mfg. Co. ..702, 726
Cunningham, Inc., E. T. Inside Front Cover
Cuno Engineering Corp., The ..750

D

Daven Radio Corp. 721
DeForest Boxing Course, Jimmy 768
Deutschman Co., Tobe 694

Page

Dictograph Products Corp. 698
Distantone Radios, Inc. 690
Dodge's Institute 702
Dongan Electric Mfg. Co. 768
Donle-Bristol Corp., The 744
Doolan Mfg. Corp., Jas. F. 754
Dubilier Condenser & Radio Corp. 718
Duro Metal Products Co. 764

E

Easton Coil Co. 748
Electrad, Inc. 741
Electric Specialty Co. 752
Electro-Magnetic Tool 762
English-Whitman Products, Inc. 758
Engineers' Service Co. 764
Erie Fixture Supply Co. 730

F

Fansteel Products Co., Inc. 683
Fawcett Publications, Inc. 726
Ferbend Electric Co. 745
Ferguson, Inc., J. B. 734
Ferranti, Inc. 691
Fisher, C. C. B. 762
Fishwick Radio Co. 708
Florentine Art Products, Inc....762
Formica Insulation Co., The 743
Freshman Co., Inc., Chas. ...775

G

Gardiner & Hepburn, Inc. 770
Gearhart-Schleuter Radio Corp. 688
Gem Tube Co. 712
General Electric Co. 765
General Industries Co., The ...760
General Instrument Corp. 704
General Mfg. Co. 767
General Radio Co. 737
George Electric Co. 700
Goodrich Rubber Co., The B. F. 754
Globe Import-Export 765
Gould Storage Battery Co., Inc. The 722
Gray & Danielson Mfg. Co. ...723
Grigsby-Grunow-Hinds Co. 728

H

Hammarlund Mfg. Co. 730
Hammarlund-Roberts 725
Hampton-Wright, Inc. 736
Hawkeye Radio Co. 738
High Frequency Labs. 696
Hommel & Co., Ludwig 744

I

Ideal Products Co. 734
Illinois Stamping & Mfg. Co....714
International Correspondence Schools 768
International Radio Co. 751
Ivorylite Radio Panel Co. 726

Page

J

J. M. P. Mfg. Co. 736
Jefferson Electric Mfg. Co.....700
Jewell Electrical Instrument Co. 748

K

Karas Electric Co. 727
Kelleradio, Inc. 769
Kellogg Switchboard & Supply Co. 693
Kelsey Co., The 726
Kodel Radio Corp.....759,761
Kokomo Electric Co. 740

L

Lacault Radio Elec. Labs., R. E. 760
Lacey & Lacey 767
Lancaster & Allwine 742
Laurel Motors Corp. 754
Liberty Bell Mfg. Co. 688
Listen-In Co., The 698
Lynch, Inc., Arthur H. 712

M

M. & H. Sporting Goods Co. ..770
M-S Syndicate 768
Madison Radio Corp. 686
Magnavox Co., The 719
Martin-Copeland Co. 703
Massachusetts Radio School ...752
Metro Electric Co. 681
Midwest Radio Corp. Inside Back Cover
Mogul Electrical Labs. 716
Murray Distributor 696
Muter Co., Leslie F. 746

N

National Carbon Co. 685
National Co., Inc. 767
National Radio Institute ..623, 684
National, State & Local Tuberculosis Ass'n of the U. S., The 706
Newark Electric 748
Newark Pen Co. 682
New England Mills Co. 700
Norden-Hauck, Inc 771

O

Omnigraph Mfg. Co., The 722
Ozarka, Inc. 624

P

Pacent Electric Corp. 757
Palmer & Palmer 692
Parker, C. L. 769
Penn Radio Sales Co. 762
Pilot Electrical Mfg. Co. 735
Polymet Mfg. Corp. 698
Ports Mfg. Co. 746
Potter Mfg. Co. 708
Premier Electric Co. 688, 714
Press Guild, The 775
Prest-O-Lite Co., Inc., The 701

Page

R

Radiall Co. 709
Radio Association of America ...771
Radio Corporation of America Back Cover
Radio Foundation, Inc. 720
Radio Institute of America 686
Radio Receptor Co. 71
Radio Specialty Co. 73
Randolph Radio Corp. 696, 708, 714, 718, 744, 760, 761
Raytheon Mfg. Co. 715
Roll-O Radio Co., The 770
Rono Mfg. Co. 734

S

Samson Electric Co. 696
Scanlon, Everett 768
Service Battery Co. 724
Seymour Co. 762
Shure Radio Co. 730, 752
Silver-Marshall, Inc. 716
Sonatron Tube Co. 714
Southern Toy Co., Inc., The 773
Spartan Electric Corp. 738
Standard Radio Co. 704
Starrett Mfg. Co. 769
Steinite Labs. 752
Sterling Mfg. Co., The 742, 758
Swift & Anderson 704
Syd Storage "B" Battery Co. ...702

T

Teletone Corp. of America 760
Thomas Battery Corp. 750
Thor Radio Mfg. Co. 704
Thordarson Electric Mfg. Co. ..713
Tower Mfg. Corp. 617

U

Union Radio Corp. 767

V

Valley Electric Co. 739
Van-Ashe Radio Co. 750
Velvetone Radio Corp. 694

W

Walker Co., The Geo. W. 740
Wayne-Andrews Co., Inc., The..765
Webster Co., The 763
Western Radio Mfg. Co. 716
Westingale Elec. Co. 687
Westinghouse Elec. & Mfg. Co. 717
Willard Storage Battery Co. ...695
Windsor Furniture Co. 729
Wirthmore Co., The 764
World Battery Co. 760, 764, 770

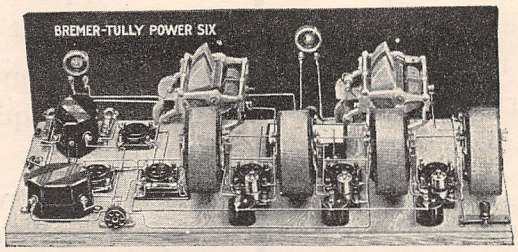
XYZ

X-L Radio Labs 716
Yale Specialty Supply Co. 756
Yaxley Mfg. Co. 718

THE BREMER-TULLY POWER-SIX

is a revision of the famous Counterphase circuit (Patented) to take advantage of the latest improvements in Tubes, Resistances and other parts.

It is easier to build, balance and operate. Two-dial control simplifies tuning. Shielding is not required with B-T patented coils,—the really successful toroids. Selectivity is admittedly wonderful,—and power tube output gives tone quality up to the latest standards.



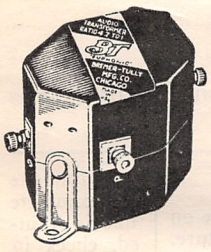
The Power-Six Kit includes essential parts totaling $45.10, with 4-color diagrams and instructions.

Price of P-6 Kit $41.50. Diagrams only, 90c

Before you buy a B-Eliminator it will pay you to investigate the B-T B-Power Unit

No guess-work,—no variable controls, (150 volts at 60 mils.)
PRICE $49.50

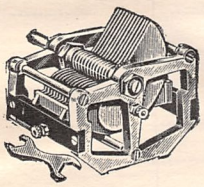
PARTS THAT INSURE SATISFACTION



B-T Euphonic Audio Transformer

The year's developments have proved there is no better method of audio amplification than the use of good transformers. B-T Euphonic is not surpassed at any price:

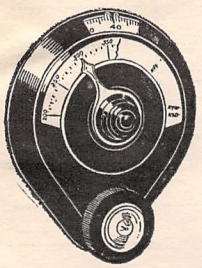
Output Transformer $5.50
2.2 to 1 .....Ratio 5.00
4.7 to 1 .....Ratio 5.75



LIFETIME CONDENSERS

Use B-T Condensers,—most sensible and best for your money,—their excellence is never questioned.

Made in straight line wave length and straight line frequency type—all popular sizes—moderately priced.



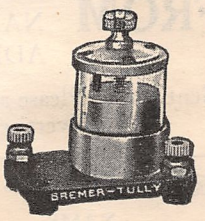
TUNING CONTROL

The B-T Tuning Control becomes steadily more popular because it's better. Geared 12 to 1, just right for accurate tuning. Reads in degrees, station call letters or wavelengths. Fits condensers turning either way,—It will be good as new when many others have become worthless.

Black and Gold $2.50
Brown and Gold 3.50

MIKRO MIKE CONDENSER

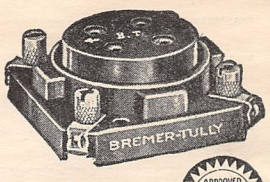
Capable of micrometer adjustment between one half and 30 m.m.f. Cannot be short circuited. Glass dielectric unaffected by temperature or climatic conditions—Used in the Power-Six Kit. **Price $1.00 ea.**



UX ABSORBER SOCKET

There is no other socket which prevents shocks and also stops vibrations as does this B-T Type UXA (Illustrated) **Price 75c**

Type UXD for detector with additional side damping mufflers. **Price $1.00**



"BETTER TUNING"

The 10th (Revised) Edition of Better Tuning is ready, 60 pages, the kind of information on radio you don't find elsewhere. Instructions for changing Counterphase to Power-Six. Full description of latter. Treatise of new forms of amplification. Why the B-T Eliminator is different, the weakness of changing inductance with capacity, etc., etc. Postpaid 10c.

APPROVED RADIO NEWS LABORATORIES 1927

Bremer Tully

Manufacturing Co.
520 So. Canal Street
CHICAGO, ILL.

RADIO NEWS READERS' BUREAU

Time and Postage Saver

IN every issue of RADIO NEWS you undoubtedly see numerous articles advertised about which you would like to have further information. To sit down and write an individual letter to each of these respective concerns, regarding the article on which you desire information, would be quite a task.

As a special service to our readers, we will write the letters for you, thus saving your time and money.

Just write the names of the products about which you want information, and to avoid error the addresses of the manufacturers, on the coupon below and mail it to us.

If the advertiser requires any money or stamps to be sent to pay the mailing charges on his catalogue or descriptive literature, please be sure to enclose the correct amount with the coupon.

We will transmit to the various advertisers your request for information on their products.

This service will appear regularly every month on this same page in RADIO NEWS.

If there is any Manufacturer not advertising in this month's issue of RADIO NEWS, from whom you would like to receive literature, write his name, address and the product in the special section of the coupon below.

TEAR ALONG THIS LINE

TO: READERS' SERVICE BUREAU, RN-12-26
Experimenter Publishing Co., Inc., 53 Park Place, New York, N. Y.

FROM WRITE YOUR NAME and ADDRESS HERE:
NAME .....
ADDRESS ..... CITY, STATE.....

Gentlemen: Please advise the firms listed below that I would like to receive detailed information on their product as advertised in the.....issue of RADIO NEWS.

☞ **DO NOT USE THIS COUPON FOR TECHNICAL QUESTIONS**

NAME	ADDRESS (Street — City — State)	List here specific article on which you wish literature.	If Catalogue of complete line is wanted, check in this column

☐ Check here if you are a dealer

Your Dealer's Name .....

Address .....

RADIO NEEDS TRAINED MEN!

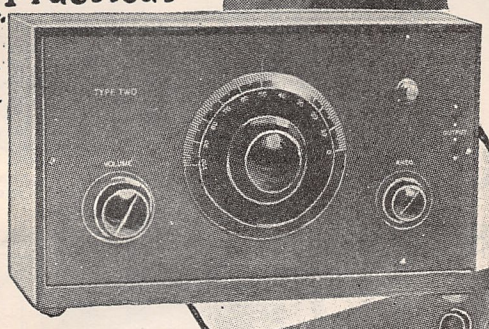
I Will Train You At Home To Fill a Big Pay Radio Job

If you're earning a penny less than $50 a week, clip coupon now. Send for AMAZING FREE BOOK, "Rich Rewards in Radio." Why go along at $25 or $35 or $45 a week, when you could earn $50 to $250 in the same six days, as a Radio Expert? Hundreds of N. R. I. trained men are doing it—why can't you?

"I give you all this apparatus so you can learn quickly at home the Practical Way"

J. E. S.

FREE OF EXTRA COST



Earn $50 to $250 a Week—

RADIO EXPERTS IN BIG DEMAND

Radio needs trained men. Get into this new live-wire profession of quick success. It's the trained man, the Radio Expert, who gets the big jobs of this profession—paying $75, $100, $200 a week and up. Every day N. R. I. trained men are taking good places in the Radio field—men just like you—their only advantage is TRAINING. You can prepare just as they did, by new practical methods. Our tested clear training makes it easy for you. Big Free Book contains all the proof.

You Learn Quickly In Spare Time

So sure am I that I can train you successfully for a better future in this new Big-Pay profession, that I guarantee your training with a money-back bond. Lack of experience or education won't hold you back—common schooling all you need to start. You can stay home, hold your job, and learn quickly and pleasantly in your spare time. My practical, helpful methods enable you to start RIGHT AWAY toward one of the bigger Radio jobs paying $50 to $250 a week. No delay, no losing time from work—no scrimping or scraping to get your training.

Operates WMAQ

"Accepted a position with the Chicago Daily News Station WMAQ. MY INCOME PRACTICALLY DOUBLED, thanks to you. I handle all consultation, also do operating. Your course taught me not only the theoretical but also the practical knowledge that makes my work easy for me." Keith Kimball, Station WMAQ, Chicago, Ill.

You Get All of This

All instruments shown here and others sent to all my students free of extra cost under short time special offer Clip coupon now—find out all about this big unequalled offer while you still have time to take advantage of it. This training is intensely practical—these instruments help you do the practical work. You learn workmanship and get added confidence in your ability.

$70 In One Day For T. M. Wilcox

"I am in business for myself and RECENTLY MADE $70 in ONE DAY. I was an electrician of rich experience, occupying a splendid position as telephone superintendent when I enrolled with you believing it would open up greater opportunities—have not been disappointed. Estimate Radio will be worth tens of thousands of dollars to me in next few years." T. M. Wilcox, Belle Island, Newfoundland.

World Famous Training That "Pays for Itself"

My Radio course World-Famous as the training that "pays for itself." Make more money QUICK when you take up this practical course. Work on millions of antennae, receiving sets, offers you big chance to make spare time cash while you're learning. I'll show you how—teach you the latest "dope," furnish you with business cards, show you how to get the business and make it pay. My students don't wait a year to increase their income—they report QUICK INCREASES as a result of this course—often two or three weeks after starting.

Howard Luce, Friedens, Pa. made $320 in 7 weeks during spare time. D. H. Suitt Newport, Ark., writes, "While taking the course I earned in spare time work about $900." Earl Wright, Omaha, reports making $400 in a short time while taking course—working at Radio in spare time! Sylvester Senso, Kaukauna, Wis., made $500. These records not unusual—these men a few of hundreds.

Your Satisfaction Guaranteed

We who know the results this practical tested training gets—the increased earnings it has brought to men everywhere—stand behind it all the way with a signed guarantee bond that we give you when you enroll. On completion if you're not entirely satisfied in every way, you get back every cent you've paid us. No strings to this offer—you yourself are the only judge. Get started today! It's your big chance for one of the bigger Radio jobs—mail coupon NOW for my Big FREE BOOK and proof! No obligation.

Get This FREE BOOK

Most amazing book on Radio ever written—full of facts and pictures—tells all about the great new Radio field, how we prepare you and help you start. You can do what others have done—GET THIS BOOK. Send coupon today—no obligation.

J. E. SMITH, President
NATIONAL RADIO INSTITUTE
Dept. PW1, Washington, D. C.

MAIL THIS COUPON TODAY

J. E. SMITH, President
NATIONAL RADIO INSTITUTE
Dept. PW1, Washington, D. C.

Dear Mr. Smith—Without obligating me in any way, send me your free book, "Rich Rewards in Radio" and all information about your practical, home-study Radio Course.

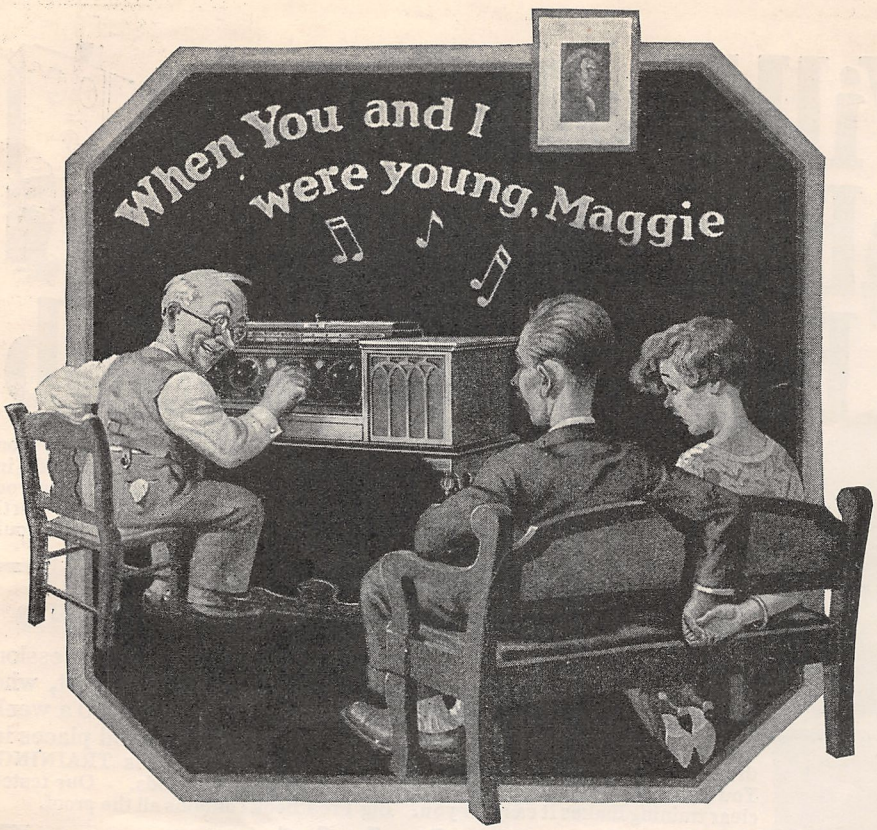
Name.....Age.....

Street Address.....

Town.....State.....

EMPLOYMENT SERVICE TO ALL GRADUATES

Originators of Radio Home-Study Training



Many Are Being Fooled in Radio By Believing Service Unnecessary

ANY radio, no matter what its price may be, nor who makes it, will only be as satisfactory as the trained service behind it.

In buying a radio there are a number of important things to consider—
APPEARANCE—
TONE—
VOLUME—
DISTANCE—
EASE OF TUNING—
and last but far the most important—
SERVICE.

Tone and Volume can very easily be determined by listening. The only real way to prove distance and ease of tuning is by operating the instrument yourself, but the quality of service must be determined only by careful investigation.

Far too often it seems customary to claim that radio service is unnecessary. For four years this company has been building a factory trained service organization until today it consists of 4364 men who know Ozarka instruments in every detail. These men have been trained directly under Ozarka Engineers, the men who originated and developed Ozarka Instruments.

You'll find it well worth your time to investigate this organization before you decide on your radio. A trained Ozarka service man is near you—why not discuss this matter with him?

When anyone tells you that radio service is not necessary, think it over, your own good sense will tell you differently. You have a right to receive from your radio consistent operation, night after night and year after year—the right service by a service man who knows how, will guarantee you that lasting satisfaction you are entitled to.

The claim that service will not be necessary is the poorest type of salesmanship—it only leads to dissatisfaction later—far too often it is used to cover up the fact that the seller is not in a position to deliver service.

In the past, the selling of radio instruments has depended largely on having stock on hand to deliver—in the rush to buy very few paid any attention to what service could be delivered in case any little trouble came up.

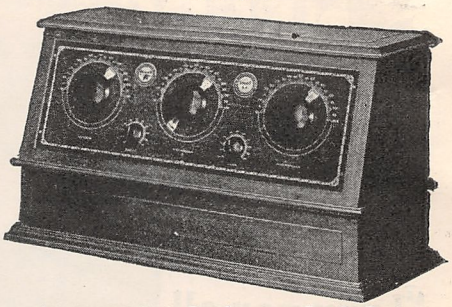
Today, service in radio is not only being recognized and demanded but people who know, go even farther and demand—service by factory trained men.

You would never consider letting any all round mechanic repair your car—then treat your radio in exactly the same manner. Demand not only service but the service of men who know—the day of the radio wizard who knows all radio instruments is gone—the factory trained service man has taken his place.

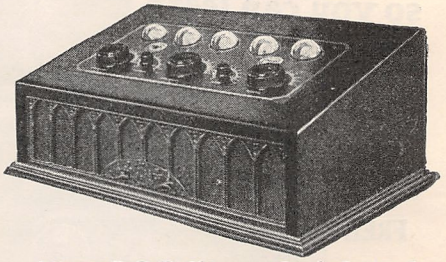
OZARKA
INCORPORATED

120 W. Austin Avenue A CHICAGO, ILL.

TRADE MARK REGISTERED



$132.50 F. O. B. Chicago. Ozarka Senior 5 Tube Model complete with Loud Speaker and all accessories.
Also built in a 7 Tube Model



$100 F. O. B. Chicago. Ozarka Junior 5 Tube Model complete with built-in speaker and all accessories.

$215 F. O. B. Chicago. Ozarka Console 5 Tube Model, solid walnut cabinet, complete with all accessories.
Also built in a 7 Tube Model

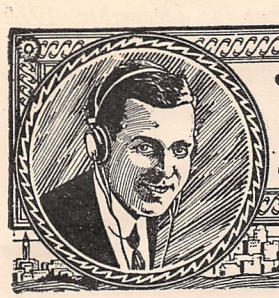
We have a few Openings for the Right Men

WHILE there are today 4364 Ozarka representatives, some territory is still open. We want men who believe in the future of radio—men who are tired of working for some one else—men who would like to add to their present income by devoting their evenings to Ozarka.

At the start you can keep your present position. Later on, after you have proven what you can do, then you will give us all your time because it will pay far more than your present position.

The man we want may not have much money but he is not broke. He has lived in his community for some time—he has a reputation that his word is good. He may not have made any startling success but he has never "put over something" just to make money. He may know nothing about radio or salesmanship but he will be successful if he is willing to study what we are willing to teach him, without cost.

The field in radio is wide open for the trained man. The success of the 4364 Ozarka representatives proves what men can do. If you are interested, ask for a copy of the Ozarka Plan, a 100 page book which tells a true story of how big money and a permanent business can be built in radio. It is a story of life; of why some men fail while others succeed. This book has shown many men how to start making extra money immediately and within a very short time establish a business of their own.



RADIO NEWS

HUGO GERNSBACK, Editor and Publisher

EDITORIAL AND GENERAL OFFICES, 53 PARK PLACE, NEW YORK

Vol. 8 DECEMBER, 1926 No. 6

EDISON AND RADIO

By HUGO GERNSBACK

THOMAS A. EDISON has recently been quoted in the press as saying that Radio is a dismal failure. The following remarks on the subject are attributed to Mr. Edison: "The radio is a commercial failure, and its popularity with the public is waning. Radio is impractical commercially and esthetically distorted, and is losing its grip rapidly in the market and in the home. There is not ten per cent. of the interest in radio that there was last year. Radio is a highly complicated machine in the hands of people who know nothing about it. No dealers have made any money out of it. It is not a commercial machine because it is too complicated. Reports from 4,000 Edison dealers who have handled radio sets show that they are rapidly abandoning it, and as for its music—it is awful," comments the Wizard of Menlo Park. "I don't see how they can listen to it.

"Thousands of people have signed a petition asking that sopranos be kept off the air. Of course most of them don't know that the soprano voice distorts the radio. The phonograph is coming into its own because the people want good music. The fact is that radio has never had a high peak of popularity. In towns where 25 or 30 dealers were handling radio sets, only one or two are now handling them. A farmer five miles from town buys a radio, perhaps on the installment plan. A wire becomes loose. The dealer has to arrange to fix it. This happens time and time again. The business becomes unprofitable for the dealer to engage in. He does not make any money out of it. None of them has. They are giving it up as fast as they can. It is not a commercially successful machine, because it is too complicated."

¶ . . . in which the Editor takes issue with Mr. Edison's claim that Radio is a failure; yet it is pointed out that the Radio Industry owes Edison a great debt; wherein facts and figures are given to show that Radio is on a steady increase; granting that neither Radio nor the phonograph is yet perfect; how the interest in Radio is steadily increasing, and radio dealers are now making good money.

Turning to the musical side of the question, Mr. Edison chuckled in his characteristic manner, "Static is awful, and the difficulties of tuning out—and now they are stealing each other's wavelengths! It is too bad that the radio has to be so complicated. It was a big and interesting thing and the people responded to it, but they want good music and they have found it is not to be had on the radio. That is why the phonograph is reclaiming its own."

Incidentally, this outburst from the dean of modern electricity was in connection with the announcement of Mr. Edison's latest invention, his 40-minute phonograph record—a great achievement, and one that without doubt will be of much benefit to the phonograph industry.

Since the publication of this famous interview with Mr. Edison, the press, and particularly the radio press over the entire country, has been more or less agitated. The following comments of mine, most of which were printed in the *New York Times* of September 26, and the *New York Evening Post* of the same date, were made by me at the time, and are here somewhat amplified:

I have too high a personal opinion of Thomas A. Edison to wish to say anything of a controversial nature, or anything that would even border on discourtesy to the great inventor, but I do believe that Mr. Edison has not been recently in touch with radio sufficiently to appreciate fully the tremendous advances that have been made. Mr. Edison is a busy man, and a tremendously busy inventor. It would be well-nigh impossible for him to be in touch with all of the various commercial phases of radio all over the country; and like other executives he obtains his reports from subordinates, and such reports often as not may be highly colorful and even wrong.

Right here I wish to pay a tribute to Mr. Edison that the radio industry so far has been unwilling to accord him. If it were not for Mr. Edison and the "Edison Effect," radio would not be what it is today. It is the Edison Effect that has made possible our present vacuum tubes, now used universally in radio. Radio, therefore, owes a tremendous debt to Thomas Alva Edison; and I recommend to the radio industry that it acknowledge this debt more frequently in the future.

As to Mr. Edison's remarks, the statements that follow are facts which can be checked up by any one who is unbiased. They are not given with any idea of starting a controversy.

Rather than waning in popularity, it is well known that radio is on the constant increase. Witness, for instance, the recent Third Annual Radio World's Fair, in New York, where the attendance for the week was 228,000, the greatest on record of any radio show, and a tremendous increase over last year's figures. There certainly was no such interest in the phonograph when the latter was but five years old, which is the age of radio, since radio broadcasting started.

The sales of radio apparatus, for the United States alone, will reach $520,000,000 for 1926. The figures for the former years, compiled by the Radio Manufacturers' Association, are given here: 1922, $46,500,000; 1923, $120,000,000; 1924, $350,000,000; 1925, $449,000,000. These are not mere estimates, but actual figures. From orders that have been placed, the various radio trade associations know now that the 1926 figure will be exceeded in 1927. The fact is that the popularity of radio is becoming steadily greater rather than less, and no home today is considered complete without its radio set.

Radio's popularity started with the introduction of broadcasting in 1921. In five short years it has accomplished more than the phonograph did in fifteen years. The modern radio set is no more complicated than the automobile when it was five years old; and for best results the radio set should be serviced by radio dealers, just as the modern automobile is serviced by its garage. In the last analysis, radio will probably be handled by radio or electrical stores, whose staff understand the mechanism. The phonograph dealer is not always equipped to do servicing, although quite a good many phonograph stores do so.

As for quality, it is the belief of unprejudiced experts that in many cases the radio, providing it is of a good make, with a good loud-speaker, will deliver quality exceeding that of a phonograph. Neither phonograph nor radio are perfect. The best phonograph is of no avail after a record has been played several dozen times; after which, by no stretch of the imagination, can one call the result music. Furthermore, the scratchy sound produced by every phonograph is highly objectionable and is certainly worse than the few extraneous noises produced in most radio sets today.

The radio and phonograph are two different entities, and should never compete. As a matter of fact, they never do. At the same time, the phonograph has come back *only because the popularity of radio* caused the phonograph makers to turn out a product such as had never existed before.

The radio dealers are making far more money in radio now than ever before. A great number interviewed, in New York and vicinity, claim that their business was never better and is on the increase. There are pretty close to 30,000 radio dealers throughout the country today. It is true that for some time the dealers did not make money, due to the price-cutting evil, but this is rapidly being eradicated.

Some of the best sets of today combine the phonograph and the radio. Each has its particular field. You can not listen to Caruso on the radio, nor can you get the latest presidential address on the phonograph.

The radio industry today is only five years old, and it may safely be predicted that when it becomes as old as the phonograph is today we shall hardly be able to recognize it as the same development. It is admitted that radio is not yet perfect. Neither is the phonograph, nor the automobile, nor motion pictures, nor electric lights; nor, for that matter, a pair of shoes.

Mr. Hugo Gernsback speaks every Monday night at 9 P. M. from Station WRNY on various radio and scientific subjects.

New Television Apparatus

Latest Developments by Messrs. Belin and Holweck

By L. FOURNIER

(Paris Correspondent, RADIO NEWS)

THIS new apparatus is based on the modulation of a light beam exploring a photographic plate. Let us recall to those of our readers, who have forgotten that the microphone is an apparatus for modulating an electric current, that it transforms the continuous current into a very irregular one. It faithfully obeys the word, that is to say, the fundamental sound, its timbre and its harmonics. Obviously, the microphone is too crude to transform vibrations in a light beam into electric current vibrations. For this work, selenium cells or photo-electric cells are used. These cells take the same place in the transmission of pictures that the microphone takes in the transmission of sounds.

Selenium in this regard was a fine discovery, and the discovery of the photo-electric cell has re-awakened old-time hopes, although perhaps it is incapable of performing the high-frequency modulations of current required in television. We shall see later why this is the case.

TRANSMISSION

The system of transmission is represented essentially by two little oscillating mirrors (see Fig. 1), one placed above the other. The lower mirror, of very narrow width, oscillates vertically at a frequency of 500 cycles per second; the upper mirror, somewhat larger, oscillates horizontally at about 10 oscillations per second. The lower mirror, receiving the luminous beam, impresses on it as reflected 500 oscillations per second. As this beam is also received by the upper mirror, which oscillates in a line perpendicular to that of the lower mirror, the projected beam will be resolved into two sets of different oscillations, each with its own frequency and its own direction.

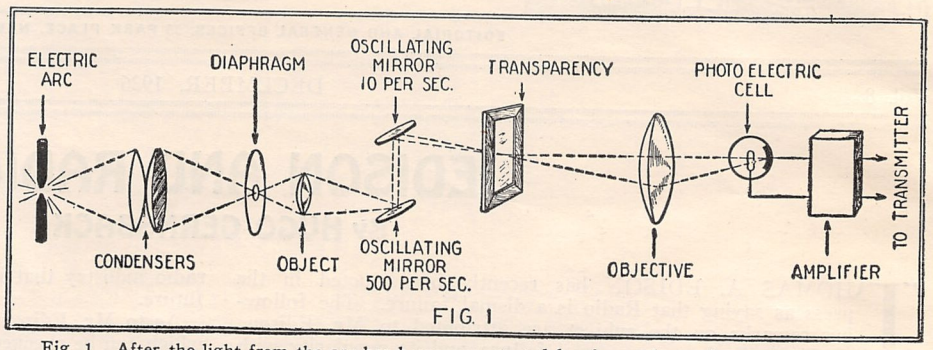


Fig. 1. After the light from the arc has been concentrated by the condenser lenses it is caused to pass in a wavy line over the transparency (See Fig. 2) and the variations of the transmitted light are registered on the cell.

Suppose now that this beam is received on a screen placed in front of it. Let us follow its course.

The oscillations of the 500-cycle mirror makes it traverse the screen uninterruptedly from right to left and left to right, but the beam at the same time answers to the oscillations of the 10-cycle mirror, which moves in a direction perpendicular to that of the first. It, therefore, is acted upon by two forces. The resultant is traced upon the screen as a luminous line of the form shown in Fig. 2; that is to say, the screen is swept over by the ray alternately from right to left and vice versa and then from above downwards and back again.

However, if we watch the screen, our eyes will see no sign of the oscillations, because the ray takes only one-tenth of a second to cover the entire surface. The persistence of vision does not permit us to see movements of such rapidity.

We have alluded to a screen to explain how the ray would traverse such a surface. In the actual apparatus this screen is replaced by a photographic plate, which the light traverses. This plate is composed of transparent and opaque sections and also has a whole scale of tints varying from intense black to absolute transparency. The pencil of light is then greatly affected in its intensity, according to whether it traverses one or another of these tints; it will therefore experience, as it leaves the plate, a modulation such that its intensity will change in value at every instant. As this light, varying as above, is projected on a photo-electric cell, the cell will pass a very feeble current, the intensity of which will depend on that of the light which reaches the cell. But so far, the actual experiments have not been made with the photographic plate. A plate was used without any half-tones, carrying only black and white portions.

The reader's attention is called to the fact that the photo-electric cell contains two electrodes, the cathode being composed of an interior layer of metallic potassium and the anode of a very light ring of nickel or platinum. The anode and cathode are connected in a circuit with a battery. When a ray of light reaches the cell, the circuit is instantly closed and the current passes. Naturally, the stronger the light, the more current passes. It is thus, by the action of this apparatus, that it is hoped to transfer light modulations into modulations of an electric current, which is connected finally to a vacuum tube amplifier before being sent to the receiving station. In practice, this amplified current will be sent into the radio transmitting station and transmitted by radio to the receiver.

After what we have said, it is easy to understand that if a reproduction on a reduced scale is desired, such as an image of the moving picture film, about 1 x ¾ inches the points will be much closer together and more numerous per unit of surface than on a screen of 6 x 9 feet area. Now, coming back to the film, a point less than .001 of an inch will be enough to reproduce an image under good conditions. The analysis of the image to be transmitted, will come down, therefore, to the production of 10,800 points. As all the surface of this image is

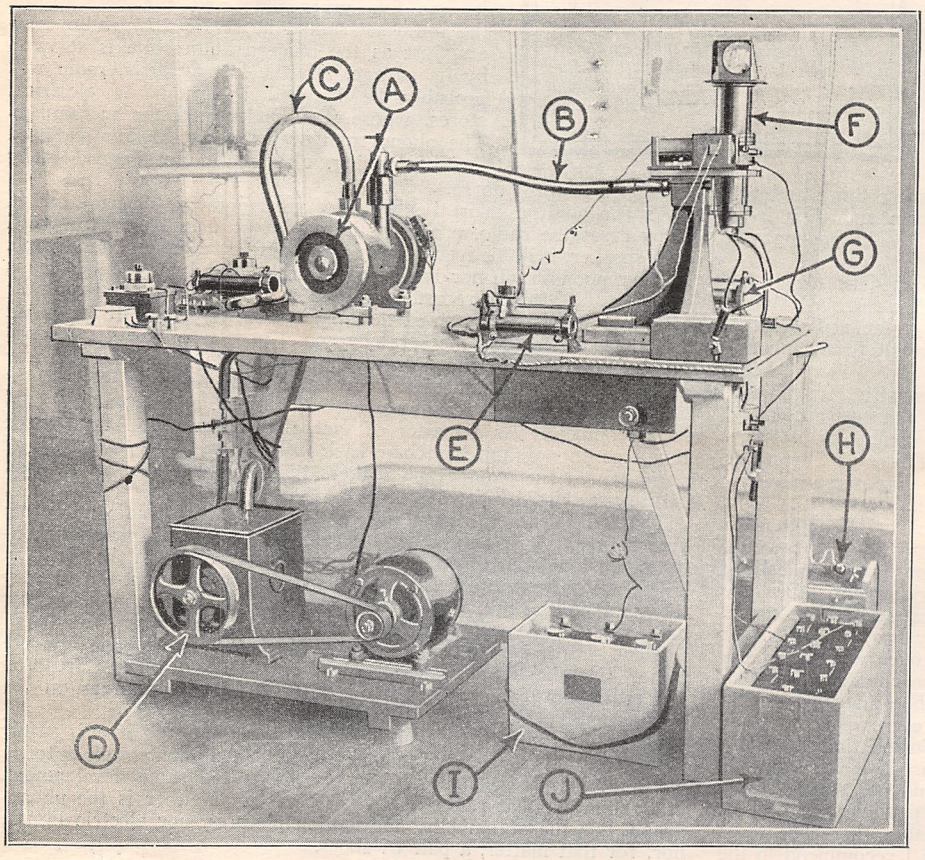


Fig. 5. The receiving apparatus: A is the Holweck molecular pump; B, tube connecting with oscillograph; C, tube connecting pumps; D, preparatory or "fore" pump; E and G, rheostats; F, oscillograph; H, I and J, batteries for concentrating coil, filament and low-frequency coil.

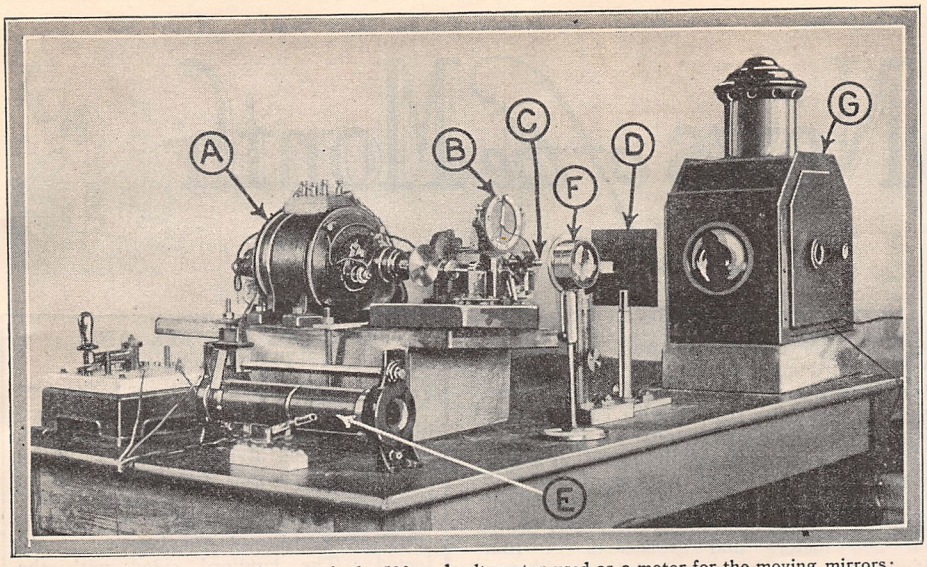


Fig. 3. The Belin transmitter: A is the 500-cycle alternator used as a motor for the moving mirrors; B, microphone of low-frequency mirror; C, "transparency" (photo film) support; D, diaphragm; E, alternator rheostat; F, objective lens; G, arc lamp.

swept over in 1/10 of a second, each point of the plate has only 1/108,000 seconds to act.

The transparent parts of the photographic negative will pass enough light to enable the cell to carry out its functions, but the semi-opaque parts will require probably a light beam of the luminous intensity of an arc-light to properly affect the cell. However, if the photographic plate is larger, the dimensions of the pencil of light should be increased. Under these conditions, we may ask if the photo-electric cell, with increased light pencil, will respond sufficiently to the changes in light?

THE SYNCHRONIZING DEVICE

The movement of the oscillating mirrors gives us a curious mechanical problem to solve, for we must not forget that the transmission apparatus must be synchronized with the receiving apparatus. The oscillating mirrors are acted on by a little alternator, which sends current of a frequency of 500 cycles per second either over a wire or by radio-transmission to the receiving stations and which acts like a motor for keeping the mirrors in motion. It is necessary to send not only the current of 500 cycles, but also another one of 10 cycles that drives the upper mirror. In the experimental arrangement the upper mirror was connected to an ordinary microphone by a light metallic bar, whose end rested upon the microphonic membrane (see Fig. 3). At the end of each oscillation of the 10-cycle mirror, the rod, by its pressure on the membrane sent a current each .1 of a second, which was received by the receiving station; and in conjunction with the 500-cycle current, acted to synchronize the sending and receiving apparatus.

It is hoped to dispense ultimately with the microphone. It is not necessary to transmit two different currents at different frequencies; it is enough to transmit a current of 500 cycles to insure the synchronism of the two stations. This is because the movements of the two mirrors are mechanically conjugate, being actuated by the same motor. At the receiver a frequency-changing apparatus may be used for lowering the frequency from 500 cycles to 10 cycles, a part of the original current at 500 cycles, being utilized directly.

HOLWECK CATHODE OSCILLOGRAPH

Here comes in the art of Mr. Holweck, expressed in his cathode oscillograph. This is simply a modification of the three-electrode tube used in radio-telephony. Above the filament, Fig. 4, is placed the grid, a circular plate with a hole in its center, above which a disc of similar form acts as the plate, which is also pierced by a central hole with a little copper tube above it. The filament requires a potential of about two volts. The varying potential in the modulated circuit is applied between grid and filament. Finally, the plate is kept at a constant potential of 1,500 volts by a special battery.

The apparatus thus formed being in action, there is produced between filament and plate, a stream of electrons which is "canalized" in the vertical tube surrounded by a little coil. The action of this is to concentrate in a very fine ray the invisible shaft of electrons. Their bombardment is made visible by their reception on a fluorescent screen placed in the upper part of the oscillograph. We must add that the oscillograph tube is evacuated, by a Holweck molecular pump. (Fig. 5.)

The current, modulated at the transmitter, and picked up by the receiver reaches the filament and the grid of the oscillograph tube. This current will introduce a disturbance in the normal emission of electrons, a disturbance which corresponds exactly with the variations of the modulated current at the transmitter. The luminous point produced on the fluorescent screen of the oscillograph tube varies in intensity in accordance with the passage of the luminous pencil at the transmitting station, as it traverses light and dark portions of the photographic plate. This phenomenon is very apparent when the point is kept fixed upon the fluorescent screen. It gives a little blue speck of light, comparable to a star on a beautiful winter night.

But this only gives us a fixed point on the screen. This is far from the reproduction of the image! What are we going to do? Our readers know that an emission of electrons is very sensitive to the presence of a magnetic field. The presence of a small coil surrounding the tube of the oscillograph, which "canalizes" the electrons, shows its sensitiveness very clearly. When it is not excited the stream of electrons fills the little tube. When a current passes, the stream is contracted and the trace, which it produces on the screen, shrinks up until it is only a brilliant point.

Putting aside the question of television, we are here face to face with some very curious electrical phenomena. The stream of electrons, in fact, is displaced in any direction whatever, merely by bringing a bar magnet near the oscillograph; the luminous trace will be seen to describe a circle on the screen. Remove the magnet and the point returns to the center. This extreme sensitiveness has been utilized for making this point of light repeat the movements that the mirrors give to the pencil of light, at the transmitting station.

Two ordinary coils are placed near the oscillograph at an angle of 90°. Through one is passed the 500-cycle current and through the other the 10-cycle current. After

(*Continued on page 739*)

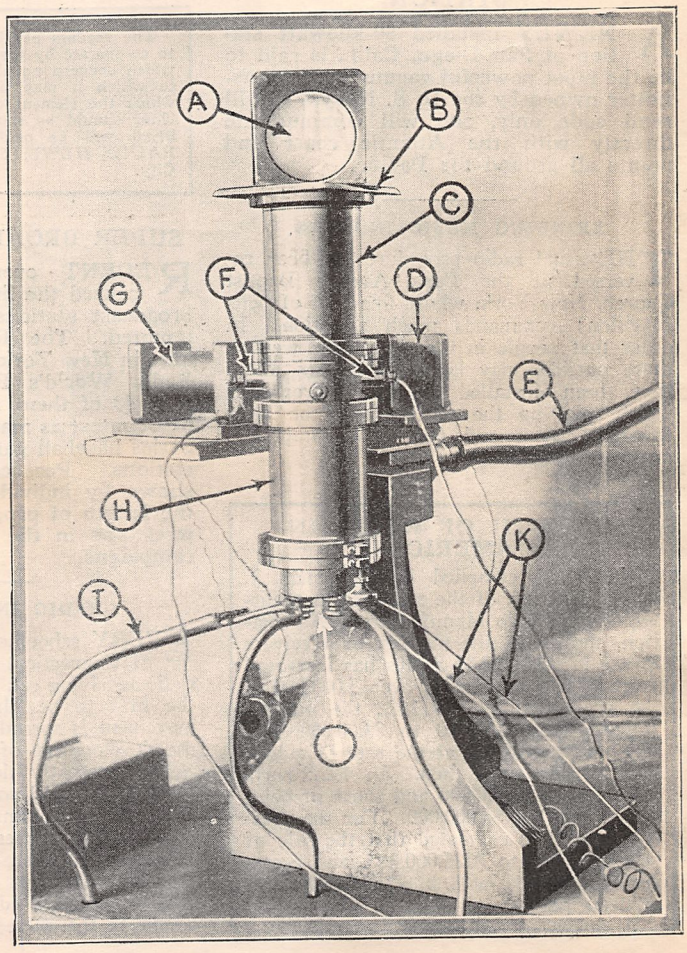
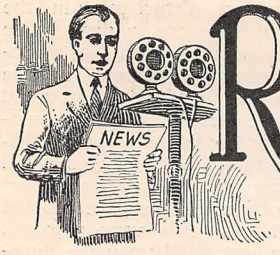


Fig. 6. The Holweck oscillograph: A is a prism on which visible images form; B, fluorescent screen of calcium tungstate; C and H, oscillograph tube; D, low-speed electric motor; E, tube from molecular vacuum pump; F, terminals of the concentrating coil; G, high speed motor; I, plate connection, (1500 volts); J, filament connection; K, grid filament lead.



Radio News of the Month

MEASURING CONTINENTAL MOVEMENTS

THE theory that the continents are not fixed in position, but are very gradually drifting over the earth's surface, has met with much favor among scientists in late years. The Washington Naval Observatory is co-operating in a series of world-wide measurements which will determine more accurately than ever before the exact relative positions of geographical stations. Radio, being almost instantaneous, affords the means of synchronizing the clocks which will determine exactly the differences in time, and consequently in longitude.

A GAME BETWEEN ANTIPODES

THE British House of Commons and the Australian Legislature will play a radio chess match on the occasion of the opening of the new Australian capitol at Canberra next May. For this longest-range match, the Amalgamated Wireless Company of Australia and the British Post Office will transmit the messages without tolls. As Canberra is ten hours ahead of London in time, many moves may be answered the day before they are made.

POWERFUL NEW NAVAL STATION

A NEWLY installed 80-kilowatt station at San Diego, Calif., is said to be the most powerful vacuum-tube transmitter owned by the U. S. Navy. It will send code only, and will communicate directly with the Atlantic coast and points all around the Pacific.

BRINGING MUSIC INDOORS

THE usual radio procedure has been reversed at the Park Avenue Baptist Church, New York, whose fine peal of bells (carillon) commands much attention. In order that people in the church, as well as those outside, may hear the chimes, there have been installed special microphones which take up the music from the most favorable point and feed it to amplifiers in the auditorium.

GROWTH OF RADIO IN AMERICA

FIGURES compiled by Chairman J. B. Hawley, of the statistical committee of the Radio Manufacturers' Association, show that the number of receivers in use in the United States has increased from 37,000 in 1920 to over 5,000,000 at the present time. In 1922 the number jumped from 150,000 to 2,000,000, and has been increasing at the rate of a million a year since then. In 1922 parts sales were $40,000,000 and those of completed sets but $5,000,000. For the present year, it is estimated that the sale of sets amounts to $225,000,000, and accessories as much, with but $75,000,000 for separate parts.

NEW FOREIGN RADIO STATIONS

STATION HHK, Port au Prince, Haiti, is heard quite strongly in the South; it transmits on 360 meters with a 1-kilowatt set. Sao Paulo, Brazil, with equal power, has the call SQIG, and works on 450 meters. New Zealand has placed in operation a 500-watt station, IYA, at Auckland, and will have another in a few weeks at Christchurch. Bratislava, Czechoslovakia, uses 500 watts on 300 meters and broadcasts in four languages. A super-power station, with two mountains for aerial supports, 10,000 feet above sea level, is now nearing completion at Herzogstand, in Upper Bavaria (Germany) and will, it is said, use 1000 kilowatts when under full power. China, is erecting a 50-kilowatt station at Pekin, for trans-Pacific communication. It will have six 1,000-foot towers.

BROADCASTING AN ARMY

A "MILITARY TATTOO," reproducing the sound of an army in motion, was a novelty broadcast from 2LO, London, not long ago. The tramp of marchers, the rolling of guns and tanks, and the clatterings and rumblings of all the panoply of Mars resounded in the ears of listeners. It was, however, an illusion, and its hearers were left to guess the ingenious methods of producing it.

The readers of RADIO NEWS are invited to co-operate by the contribution of news items which concern novelties in radio or in the uses to which it may be put; especially those in which the element of human interest is found. They should be short; for each one published $1.00 will be paid. Address News Editor, RADIO NEWS, 53 Park Place, New York City.

SUPER BROADCAST PROGRAMS

RECENT events of interest have caused the linking together of more broadcast stations than ever before attempted. The Radio Industries' Banquet in New York, on the occasion of the Radio World's Fair, mustered no less than 43 of them, and the Dempsey-Tunney contest as many as 33. The World's Series baseball games were covered by 22 stations. Per contra, a tendency is shown by individual stations to restrict the length of programs of only local interest—as in the case of state political campaigns.

RADIO IN THE SCHOOL

EVERY schoolhouse in the rural regions of Connecticut is to be equipped with a radio receiving set. While this state will be the first to be thoroughly equipped, the movement is spreading, being encouraged by the development of the U. S. Radio Farm School, recently described in these pages. In Arkansas 112 vocational teachers will direct radio programs to farmers in as many rural school houses. Every schoolroom in Atlanta, Ga., also will have a radio loudspeaker, so it can be seen that the city as well as country educational authorities are awake to the value of radio.

AERIAL RIGHTS AND INTERFERENCE

CHICAGO has brought forth the first lawsuit between individuals to determine who has the rights to the ether. A radio fan was living happily until an amateur moved into the same apartment house and started up a transmitting set. While it was in operation, the B. C. L. could get nothing else, and therefore objected. The landlord sided with the owner of the transmitter; so the aggrieved tenant has brought suit, with the backing of the Broadcast Listeners' Association, to determine what are his rights to uninterrupted reception.

RADIO MUST NOT BE MUSICAL

A NOVEL decision has been given by the legal authorities in New South Wales, Australia. The law forbids the use of musical instruments in tap-rooms, but some ingenious publicans have run extension cords from their receivers to loud-speakers in the bars, and give their customers the sporting results. This practice has been authorized, providing the speaker is turned off when a musical number is coming over.

THE WIRELESS RADIO DANCE

THIS novelty, the practicability of which was explained in RADIO NEWS for last February, has appealed to oversea lovers of the terpsichorean art. In a Berkhamstead (England) hotel 20 couples danced recently to radio music unheard by the amazed spectators. Each dancer wore inconspicuous headphones through which he or she heard the phantom strains from the distant orchestra.

CALL PIGS BY RADIO

OUT in the great West, where even city dwellers do not lose their touch with the land, one of the big events at the radio show in Omaha was a pig-calling contest by expert swineherds. It is not recorded whether any farmers called in their pet porkers and put the earphones on them, in order that the animals might judge the excellence of the performance.

(*Continued on page* 763)

RADIO MAKES THE DEAF HEAR

FROM Norway, Maine, comes the report of interesting experiments performed by Charles D. Seely, a radio enthusiast. With the use of a powerful radio set, it was found possible for people who were born deaf to hear music and the sound of voices from the loudspeaker; though the voices were, of course, unintelligible to those who had never before listened to speech. The music, however, was most pleasing. The success of the experiment presents possibilities worthy of the fullest investigation.

List of Broadcast Stations in the United States

Radio Call Letter	BROADCAST STA. Location	Wave (Meters)	Power (Watts)
KDKA,	East Pittsburgh, Pa.	309.1	Var.
	(Various short-wave transmissions)		
KDLR,	Devils Lake, N. D.	231	5
KDYL,	Salt Lake City, Utah	246	50
KFAB,	Lincoln, Neb.	340.7	5000
KFAD,	Phoenix, Ariz.	273	100
KFAF,	San Jose, Calif.	217.3	50
KFAU,	Boise Idaho	280.2	2000
KFBB,	Havre, Mont.	275	50
KFBC,	San Diego, Calif.	380	50
KFBK,	Sacramento, Calif.	535	100
KFBL,	Everett, Wash.	224	100
KFBS,	Trinidad, Colo.	238	15
KFBU,	Laramie, Wyo.	375	500
KFCB,	Phoenix, Ariz.	238	125
KFDD,	Boise, Idaho	275.1	50
KFDM,	Beaumont, Tex.	315.6	500
KFDX,	Shreveport, La.	250	100
KFDY,	Brookings, S. Dak.	305.9	100
KFDZ,	Minneapolis, Minn.	231	10
KFEC,	Portland, Ore.	248	50
KFEL,	Denver, Colo.	254	250
KFEQ,	Oak, Nebr.	268	500
KFEY,	Kellogg, Idaho	233	10
KFFP,	Moberly, Mo.	242	50
KFGQ,	Boone, Iowa	226	10
KFH,	Wichita, Kans.	268	500
KFHA,	Gunnison, Colo.	252	50
KFHL,	Oskaloosa, Iowa	240	10
KFI,	Los Angeles, Calif.	467	5000
KFIF,	Portland, Ore.	248	100
KFIO,	Spokane, Washington	273	500
KFIQ,	Yakima, Wash.	256	500
KFIU,	Juneau, Alaska	226	10
KFIZ,	Fond du Lac, Wis.	273	100
KFJB,	Marshalltown, Iowa	248	10
KFJC,	Junction City, Kansas	218.8	10
KFJF,	Oklahoma City, Okla.	261	500
KFJI,	Astoria, Ore.	246	10
KFJM,	Grand Forks, N. Dak.	278	100
KFJR,	Portland, Ore.	263	120
KFJY,	Fort Dodge, Iowa	246	50
KFJZ,	Fort Worth, Tex.	254	50
KFKA,	Greeley, Colo.	273	50
KFKU,	Lawrence, Kans.	275	500
KFKX,	Hastings, Nebr.	288.3	5000
KFKZ,	Kirksville, Mo.	225.4	50
KFLR,	Albuquerque, N. Mex.	254	100
KFLU,	San Benito, Tex.	236	20
KFLV,	Rockford, Ill.	229	100
KFLX,	Galveston, Tex.	240	250
KFLZ,	Anita, Iowa	273	100
KFMR,	Sioux City, Iowa	261	100
KFMX,	Northfield, Minn.	336.9	500
KFNF,	Shenandoah, Iowa	461.3	2500
KFOA,	Seattle, Wash.	454.3	1000
KFOB,	Burlingame, Calif.	226	50
KFON,	Long Beach, Calif.	233	500
KFOR,	David City, Nebr.	226	100
KFOT,	Wichita, Kans.	231	50
KFOX,	Omaha, Nebr.	248	100
KFOY,	St. Paul, Minn.	252	50
KFPL,	Dublin, Texas	252	20
KFPM,	Greenville, Texas	242	10
KFPR,	Los Angeles, Calif.	230.6	500
KFPW,	Carterville, Mo.	258	20
KFPY,	Spokane, Wash.	273	100
KFQA,	St. Louis, Mo.	280.2	5000
KFQB,	Fort Worth, Texas	508.2	2500
KFQD,	Anchorage, Alaska	227.1	100
KFQP,	Iowa City, Iowa	224	10
KFQU,	Alma (Holy City) Calif.	231	250
KFQW,	Seattle, Wash.	215.7	50
KFQZ,	Hollywood, Calif.	225.4	500
KFRB,	Beeville, Tex.	248	250
KFRC,	San Francisco, Calif.	267.7	50
KFRU,	Columbia, Mo.	499.7	500
KFRW,	Olympia, Wash.	218.8	50
KFSD,	San Diego, Calif.	245.8	1000
KFSG,	Los Angeles, Calif.	275	500
KFUL,	Galveston, Tex.	258	500
KFUM,	Colorado Springs, Colo.	339.9	100
KFUO,	St. Louis, Mo.	545.1	500
KFUP,	Denver, Colo.	234	50
KFUR,	Ogden, Utah	224	50
KFUS,	Oakland, Calif.	256	50
KFUT,	Salt Lake City, Utah	261	100
KFUU,	Oakland, Calif.	220	100
KFVD,	Venice, Calif.	205.4	50
KFVE,	St. Louis, Mo.	240	5000
KFVG,	Independence, Kas.	236	15
KFVI,	Houston, Texas	239.9	50
KFVN,	Fairmont, Minn.	227	50
KFVR,	Denver, Colo.	244	50
KFVS,	Cape Girardeau, Mo.	224	50
KFVY,	Albuquerque, N. Mex.	250	10
KFWB,	Hollywood, Calif.	252	500
KFWC,	San Bernardino, Calif.	291.1	200
KFWF,	St. Louis, Mo.	214.2	250
KFWH,	Eureka, Calif.	254	100
KFWI,	San Francisco, Calif.	250	500
KFWM,	Oakland, Calif.	315.6	500
KFWO,	Avalon, Calif.	211.1	250
KFWU,	Pineville, La.	238	100
KFWV,	Portland, Ore.	212.6	50
KFXB,	Big Bear Lake, Calif.	202.6	500
KFXD,	Logan, Utah	205.4	10
KFXF,	Colorado Springs, Colo.	249.9	1000
KFXH,	El Paso, Texas	242	50
KFXJ,	Edgewater, Colo.	215.7	15
KFXR,	Oklahoma City, Okla.	214.2	15
KFXY,	Flagstaff, Ariz.	205.4	50
KFYF,	Oxnard, Calif.	214.2	10
KFYJ,	Houston, Texas	238	10
KFYO,	Texarkana, Tex.	209.7	10
KFYR,	Bismarck, N. Dak.	248	10
KGAR,	Tucson, Ariz.	243.8	500
KGBS,	Seattle, Wash.	227	100
KGBU,	Ketchikan Alaska	229	500
KGBW,	Joplin, Mo.	282.8	250
KGBX,	St. Joseph, Mo.	347.8	50
KGBY,	Shelby, Neb.	202.6	50
KGBZ,	York, Neb.	333.1	100
KGCA,	Decorah, Ia.	280.2	20
KGCB,	Oklahoma City, Okla.	331	100
KGCG,	Newark, Ark.	234.2	100
KGCH,	Wayne, Neb.	434	500
KGCI,	San Antonio, Tex.	239.9	15
KGCL,	Seattle, Wash.	230.6	10
KGCM,	San Antonio, Tex.	263	10
KGCN,	Concordia, Kas.	210	50
KGCR,	Brookings, S. D.	252	
KGCU,	Mandau, N. D.		
KGCX,	Vida, Mont.	240	8
KGO,	Oakland, Calif.	361.2	5000
KGTT,	San Francisco, Calif.	206.8	50
KGU,	Honolulu, Hawaii	270	500
KGW,	Portland, Ore.	491.5	1000
KGY,	Lacey, Wash.	278.8	50
KHJ,	Los Angeles, Calif.	405.2	500
KHQ,	Spokane, Wash.	394.5	1000
KHX,	Los Angeles, Calif.	119.9	500
KICK,	Anita, Ia.	273	100
KJBS,	San Francisco, Calif.	220	5
KJR,	Seattle, Wash.	384.4	1000
KLDS,	Independence, Mo.	440.9	1000
KLS,	Oakland, Calif.	250	250
KLX,	Oakland, Calif.	508.2	500
KLZ,	Denver, Colo.	384.4	500
KMA,	Shenandoah, Iowa	461	500
KMJ,	Fresno, Calif.	234	50
KMJP,	Kansas City, Mo.	440.9	1000
KMMJ,	Clay Center, Neb.	238.9	1000
KMO,	Tacoma, Wash.	250	100
KMOX,	Kirkwood, (St. Lo)., Mo.	280.2	5000
KMTR,	Hollywood, Calif.	572.2	500
KNRC,	Los Angeles, Calif.	208.2	500
KNX,	Los Angeles, Calif.	336.9	500
KOA,	Denver, Colo.	322.4	5000
KOAC,	Corvallis, Ore.	280.2	500
KOB,	State College, N. M.	348.6	5000
KOCH,	Omaha, Neb.	258	500
KOCW,	Chickasha, Okla.	252	200
KOIL,	Council Bluffs, Iowa	305.9	500
KOIN,	Sylvan, Ore.	319	1000
KOMO,	Seattle, Wash.	305.9	1000
KOWW,	Walla Walla, Wash.	285.5	500
KPJM,	Prescott, Ariz.	215	
KPO,	San Francisco, Calif.	428.3	1000
KPPC,	Pasadena, Calif.	229	50
KPRC,	Houston, Texas	296.9	500
KPSN,	Pasadena, Calif.	315.6	1000
KQV,	Pittsburgh, Pa.	275	500
KQW,	San Jose, Calif.	333.1	500
KRE,	Berkeley, Calif.	256	100
KSAC,	Manhattan, Kansas	340.7	500
KSBA,	Shreveport, La.	312.6	1000
KSD,	St. Louis, Mo.	545.1	500
KSEI,	Pocatello, Ida.	260.7	500
KSL,	Salt Lake City, Utah	299.8	1000
KSMR,	Santa Maria, Calif.	209.7	100
KSO,	Clarinda, Iowa	242	500
KTAB,	Oakland, Calif.	302.8	1000
KTBI,	Los Angeles, Calif.	293.9	750
KTBR,	Portland, Ore	263	50
KTHS,	Hot Springs, Ark.	374.8	1000
KTNT,	Muscatine, Iowa	333.1	1000
KTUE,	Houston, Tex.	263	5
KTW,	Seattle, Wash.	454.3	1500
KUOA,	Fayetteville, Ark.	299.8	750
KUOM,	Missoula, Mont.	244	250
KUSD,	Vermillion, S. D.	278	500
KUT,	Austin, Texas	231	500
KVOO,	Bristow, Okla.	374.8	1000
KWCR,	Cedar Rapids, Iowa	278	500
KWG,	Stockton, Calif.	248	50
KWKC,	Kansas City, Mo.	236	100
KWSC,	Pullman, Wash.	348.6	500
KWUC,	Le Mars, Iowa	252	50
KWWG,	Brownsville, Texas	278	500
KXRO,	Seattle, Wash.	240	85
KYW,	Chicago, Ill.	535.4	2000
KZIB,	Manila, P. I.	249.9	20
KZKZ,	Manila, P. I.	270	100
KZM,	Oakland, Calif.	240	100
KZRQ,	Manila, P. I.	400	500
NAA,	Arlington, Va.	434.5	1000
WAAD,	Cincinnati, Ohio	258	25
WAAF,	Chicago, Ill.	278	500
WAAM,	Newark, N. J.	263	500
WAAT,	Jersey City, N. J.	235	
WAAW,	Omaha, Neb.	384.4 & 278	500
WABB,	Harrisburg, Pa.	204	10
WABC,	Asheville, N. C.	254	100
WABI,	Bangor, Me.	240	100
WABO,	Rochester, N. Y.	258	100
WABQ,	Havorford, Pa.	365.7	1000
WABR,	Toledo, Ohio.	263	50
WABW,	Wooster, Ohio	206.8	50
WABX,	Mount Clemens, Mich.	246	500
WABY,	Philadelphia, Pa.	242	50
WABZ,	New Orleans, La.	275	50
WADC,	Akron, Ohio.	258	500
WAFD,	Port Huron, Mich.	275	500
WAGM,	Royal Oak, Mich.	225.4	50
WAHG,	Richmond Hill, N. Y.	315.6	500
WAIT,	Taunton, Mass.	229	10
WAIU,	Columbus, Ohio	293.9	1000
WAMD,	Minneapolis, Minn.	244	5000
WAPI,	Auburn, Ala.	461.3	1000
WARC,	Medford Hillside, Mass.	261	100
WATT,	Boston, Mass.	243.8	100
WBAA,	West Lafayette, Ind.	273	250
WBAK,	Harrisburg, Pa.	275	500
WBAL,	Glen Morris, Md.	246	5000
WBAO,	Decatur, Ill.	270	100
WBAP,	Fort Worth, Texas	475.9	1500
WBAW,	Nashville, Tenn.	236.1	100
WBAX,	Wilkes-Barre, Pa.	256	100
WBBC,	Brooklyn, N. Y.	249.9	100
WBBL,	Richmond, Va.	228.9	100
WBBM,	Chicago, Ill.	226	10000
WBBP,	Petoskey, Mich.	238	200
WBBR,	Rossville, N. Y.	416.4	500
WBBS,	New Orleans, La.	252	50
WBBW,	Norfolk, Va.	222	50
WBBY,	Charleston, S. C.	268	100
WBBZ,	Chicago, Ill.	215.7	50
WBCN,	Chicago, Ill.	266	500
WBDC,	Grand Rapids, Mich.	256	500
WBES,	Takoma Park, Md.	222	100
WBNY,	New York, N. Y.	322.4	1000
WBOQ,	Richmond Hill, N. Y.	236	100
WBRC,	Birmingham, Ala.	248	50
WBRE,	Wilkes-Barre, Pa.	231	100
WBBL,	Tilton, N. H.	365	500
WBRS,	Brooklyn, N. Y.	594	100
WBT,	Charlotte, N. C.	275	250
WBZ,	Springfield, Mass.	331.1	5000
WBZA,	Boston, Mass.	331.1	500
WCAC,	Storrs, Conn.	275	500
WCAD,	Canton, N. Y.	263	250
WCAE,	Pittsburgh, Pa.	461.3	500
WCAH,	Columbus, O.	265.3	
WCAJ,	University Place, Neb.	254	500
WCAL,	Northfield, Minn.	336.9	500
WCAM,	Camden, N. J.	236	250
WCAO,	Baltimore, Md.	275	100
WCAR,	San Antonio, Texas	263	5000
WCAT,	Rapid City, S. D.	240	50
WCAU,	Philadelphia, Pa.	277.6	500
WCAX,	Burlington, Vt.	252	100
WCAZ,	Carthage, Ill.	245.8	50
WCBA,	Allentown, Pa.	254	125
WCBD,	Zion, Ill	344.6	5000
WCBE,	New Orleans, La.	263	5
WCBH,	Oxford, Miss.	242	50
WCBM,	Baltimore, Md.	229	100
WCBR,	Providence, R. I.	234	100
WCBS,	Providence, R. I.	242.5	250
WCCO,	Minn.-St. Paul, Minn.	416.4	5000
WCFL,	Chicago, Ill.	491.5	500
WCFT,	Tullahoma, Tenn.	252	
WCLO,	Camp Lake, Wis.	231	50
WCLS,	Joliet, Ill.	214.2	150
WCMA,	Culver, Ind.	258.5	500
WCOA,	Pensacola, Fla.	252	500
WCRW,	Chicago, Ill.	416.4	
WCSH,	Portland, Me.	499.7	500
WCSO,	Springfield, Ohio	248	100
WCWK,	Fort Wayne, Ind.	234.2	250
WCWS,	Bridgeport, Conn.	282.8	500
WCX,	Pontiac, Mich.	516.9	5000
WDAD,	Nashville, Tenn.	226	150
WDAE,	Tampa, Fla.	273	1000
WDAF,	Kansas City, Mo.	365.6	1000
WDAG,	Amarillo, Texas	263	100
WDAH,	El Paso, Tex.	267.7	50
WDAY,	Fargo, N. D.	261	50
WDBE,	Atlanta, Ga.	270	100
WDBJ,	Roanoke, Va.	229	50
WDBK,	Cleveland, Ohio	227	500
WDBO,	Winter Park, Fla.	240	500
WDBZ,	Kingston, N. Y.	233	10
WDEL,	Wilmington, Del.	266	100
WDGY,	Minneapolis, Minn.	263	500
WDOD,	Chattanooga, Tenn.	256	500
WDRC,	New Haven, Conn.	268	100
WDWF,	Edgewood, R. I.	440.9	500
WDXL,	Detroit, Mich.	296.9	250
WDZ,	Tuscola, Ill.	278	100
WEAF,	New York, N. Y.	491.5	5000
WEAI,	Ithaca, N. Y.	254	500
WEAM,	North Plainfield, N. J.	261	250
WEAN,	Providence, R. I.	367	500
WEAO,	Columbus, Ohio	293.9	750
WEAR,	Cleveland, Ohio	389.4	750
WEAU,	Sioux City, Iowa	275	100
WEBC,	Superior, Wis.	242	100
WEBH,	Chicago, Ill.	370.2	2000
WEBJ,	New York, N. Y.	272.6	500
WEBL,	New York, N. Y.	226	100
WEBQ,	Harrisburg, Ill.	225.4	10
WEBR,	Buffalo, N. Y.	244	100
WEBW,	Beloit, Wis.	268	500
WEBZ,	Savannah, Ga.	263	50
WEDC,	Chicago, Ill.	422.3	1000
WEEI,	Boston, Mass.	348.6	500
WEHS,	Evanston, Ill.	202.6	10
WEMC,	Berrien Springs, Mich.	385.1	4000
WENR,	Chicago, Ill.	266	1000
WEW,	St. Louis, Mo.	360	1000
WFAA,	Dallas, Texas	475.9	500
WFAM,	St. Cloud, Minn.	273	10
WFAV,	Lincoln, Nebr.	275	500
WFBC,	Knoxville, Tenn.	250	50
WFBE,	Seymour, Ind.	226	10
WFBG,	Altoona, Pa.	278	100
WFBH,	New York, N. Y.	273	500
WFBJ,	Collegeville, Minn.	236	100
WFBL,	Syracuse, N. Y.	252	100
WFBM,	Indianapolis, Indiana	268	250
WFBR,	Baltimore, Md.	254	100
WFBZ,	Galesburg, Ill.	254	20
WFCI,	Pawtucket, R. I.	229	
WFDF,	Flint, Mich.	234	100
WFI,	Philadelphia, Pa.	394.5	500
WFKB,	Chicago, Ill.	217.3	500
WFLA,	Clearwater, Fla.	265.3	500
WFRL,	Brooklyn, N. Y.	205.4	100
WGAL,	Lancaster, Pa.	248	10
WGBB,	Freeport, N. Y.	244	100
WGBC,	Memphis, Tenn.	277.6	15
WGBF,	Evansville, Ind.	236	500
WGBI,	Scranton, Pa.	240	100
WGBR,	Marshfield, Wis.	229	10
WGBS,	New York, N. Y.	315.6	500
WGBU,	Fulford, Fla.	384.4	500
WGBX,	Orono, Me.	234.2	500
WGCM,	San Antonio, Tex.	263	
WGCP,	Newark, N. J.	252	500
WGES,	Chicago, Ill.	315.6	500
WGHB,	Clearwater, Fla.	266	500
WGHP,	Detroit, Mich.	270	1500
WGM,	Jeannette, Pa	372	150
WGMU,	Richmond Hill, N. Y.	236	100
WGN,	Elgin, Ill.	302.8	1000
WGR,	Buffalo, N. Y.	319	750
WGST,	Atlanta, Ga.	270	500
WGY,	Schenectady, N. Y.	379.5	50000
WHA,	Madison, Wis.	530.4	1000
WHAD,	Milwaukee, Wis.	275	500
WHAM,	Rochester, N. Y.	278	100
WHAP,	New York, N. Y.	431	500
WHAR,	Atlantic City, N. J.	275	500
WHAS,	Louisville, Ky.	399.8	500
WHAZ,	Troy, N. Y.	379.5	500
WHB,	Kansas City, Mo.	365.6	500
WHBA,	Oil City, Pa.	250	10
WHBC,	Canton, Ohio.	254	10
WHBD,	Bellefontaine, Ohio.	222	100
WHBF,	Rock Island, Ill.	222	100
WHBG,	Harrisburg, Pa.	231	20
WHBL,	Chicago, Ill.	215.7	50
WHBM,	Chicago, Ill.	215.7	20
WHBN,	St. Petersburg, Fla.	238	10
WHBP,	Johnstown, Pa.	256	100
WHBQ,	Memphis, Tenn.	233	50
WHBR,	Cincinnati, O.	215.7	300
WHBU,	Anderson, Ind.	218.8	10
WHBW,	Philadelphia, Pa.	215.7	100
WHBY,	West De Pere, Wis.	250	50
WHDI,	Minneapolis, Minn.	278	500
WHEC,	Rochester, N. Y.	258	100
WHFC,	Chicago, Ill.	258.5	150
WHK,	Cleveland, Ohio	272.6	1000
WHN,	New York, N. Y.	361.2	500
WHO,	Des Moines, Iowa	526	5000
WHT,	Deerfield, Ill.	399.8	3500
WIAD,	Philadelphia, Pa.	250	100
WIAS,	Burlington, Iowa	254	100
WIBA,	Madison, Wis.	236	100
WIBG,	Elkins Park, Pa.	222	50
WIBH,	New Bedford, Mass.	209.7	30
WIBI,	Flushing, N. Y.	218.8	50
WIBJ,	Chicago, Ill.	215.7	50
WIBM,	Chicago, Ill.	215.7	10
WIBO,	Chicago, Ill.	226	1000
WIBR,	Steubenville, Ohio	246	50
WIBS,	Elizabeth, N. J.	202.6	10
WIBU,	Poynette, Wis.	222	20
WIBW,	Logansport, Ind.	220	100
WIBX,	Utica, N. Y.	234.2	150
WIBZ,	Montgomery, Ala.	230.6	10
WIL,	St. Louis, Mo.	258	250
WILL,	Urbana-Champaign, Ill.	260	1000
WIOD,	Miami Beach, Fla.	247.8	1000
WIP,	Philadelphia, Pa.	508.2	500
WJAD,	Waco, Texas	352.7	500
WJAF,	Ferndale, Mich.	400	
WJAG,	Norfolk, Nebr.	270	200
WJAK,	Kokomo, Ind.	254	50
WJAM,	Cedar Rapids, Iowa	268	100
WJAR,	Providence, R. I.	305.9	500
WJAS,	Pittsburgh, Pa.	275.1	500
WJAX,	Jacksonville, Fla.	336.9	1000
WJAZ,	Mount Prospect, Ill.	329.8	10,000
WJBA,	Joliet, Ill.	206.8	50
WJBB,	St. Petersburg, Fla.	254	250
WJBC,	La Salle, Ill.	234	100
WJBI,	Red Bank, N. J.	218.8	250
WJBK,	Ypsilanti, Mich.	233	10
WJBL,	Decatur, Ill.	270	500
WJBO,	New Orleans, La.	268	100
WJBR,	Omro, Wis.	227.1	50
WJBT,	Chicago, Ill.	238-468.5	500
WJBU,	Lewisburg, Pa.	211.1	100
WJBV,	Woodhaven, N. Y.	469.9	100
WJBW,	New Orleans, La.	340.7	
WJBX,	Osterville, Mass.	280	100
WJBY,	Gadsden, Ala.	270.1	15
WJJD,	Mooseheart, Ill.	370.2	1000
WJR,	Pontiac, Mich.	516.9	5000
WJUG,	New York, N. Y.	516.9	250
WJY,	New York, N. Y.	405.2	1000
WJZ,	Bound Brook, N. J.	454.3	50,000
WKAF,	Milwaukee, Wis.	261	1000
WKAQ,	San Juan, P. R.	340.7	500
WKAR,	East Lansing, Mich.	285.5	1000
WKAV,	Laconia, N. H.	224	50
WKBA,	Chicago, Ill.	209.7	200
WKBB,	Joliet, Ill.	282.8	100

At the closing date of this magazine, the list of broadcast stations is subject to daily alterations, as regards wavelengths, power, etc. We especially request stations making changes at this time to send a notification to RADIO NEWS in order that broadcast listeners may be advised as soon as possible of the new conditions which they may expect in tuning in the stations.

(Continued on page 655)

Electrifying Your Phonograph

Means for the Electrical Reproduction of Music from Disc Records

By H. B. WHIFFEN

IN company with the advancements made in the reproduction of speech and music received by radio a number of new types of phonographs have been introduced, which are so far superior to older types that there is no room for comparison between the two. It might be said that all the improvements do not lie in the machines themselves; the records are made in a new way. Heretofore, the recording of music was done mechanically and many of the bass notes and overtones were entirely lost in the process. Records are now made electrically, by the use of microphones identical to those used for broadcasting, and an audio amplifier, which in turn actuates a special electro-magnetic cutting stylus. With this improved apparatus, borrowed from radio, records can be made which contain all the low-frequency notes and overtones formerly absent and at the same time produce much more volume of sound than the old type record.

The phonographs, which have now taken on new names, fall into two distinctive types; those which reproduce mechanically and those which reproduce electrically. Those of both groups give nearly perfect reproduction of the music and voices recorded on the new discs, but the outstanding machines are the ones which do all the work electrically. Just as electrical recording has greatly improved the discs themselves, electrical reproduction has proved superior to the mechanical means.

The electrical phonographs such as the Electrola and the Panatrope are designed to operate directly from the house-lighting current. They consist primarily of an "electrical pick-up", which supplants the usual sound box; an audio-frequency power amplifier and a loud speaker, in most cases, of the cone type. Here again, devices have been borrowed from radio.

A suitable volume control is provided, which allows one to adjust the volume from a mere whisper to the full volume of an orchestra.

Those who have heard these new phonographs operate have a new realization of "musical color" and cannot hope ever again to be satisfied with an old type machine.

It is an easy matter to "electrify" the phonograph you have and use it in conjunction with the audio-frequency amplifier in your radio set and loud speaker. The results obtained will be dependent on the electrical pick-up device used, the audio-frequency amplifier and the loud speaker. We will say more about them later.

NO A.F. AMPLIFIER REQUIRED

First let us consider one type of electrical phonograph reproducer which requires no audio amplifier. The instrument is shown in the illustration of Fig. 1. It consists of a microphone, M, which is the electrical pick-up, and a case which contains a step-up transformer, a variable resistance, T, functioning as a volume control, and an automatic switch. All that is required for its operation is a radio storage "A" battery and a loud speaker, both of which connect to terminals at the rear of the case.

The illustration of Fig. 2 shows the arrangement in operation. It will be noted that the sound box and tone arm are not used, though if desired a loud-speaker unit can be mounted on the tone arm in place of the sound box and the horn of the phonograph used instead of a loud speaker.

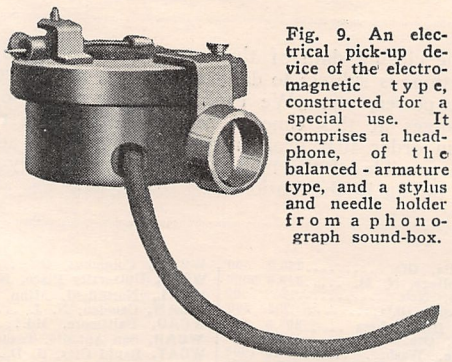


Fig. 9. An electrical pick-up device of the electro-magnetic type, constructed for a special use. It comprises a headphone, of the balanced-armature type, and a stylus and needle holder from a phonograph sound-box.

When the arm of the microphone is placed on the support attached to the side of the case, the storage battery is automatically disconnected from the unit so that no current is consumed at times when the device is not in operation. The circuit diagram of Fig. 3 gives a better idea of the arrangement. The microphone, with the battery in series when in operation, feeds directly into the primary winding of the step-up transformer. The electrical fluctuations are induced into the secondary winding of the transformer and fed directly to the loud speaker. The volume control is a variable resistance in shunt with the storage battery and controls the flow of current to the microphone and consequently the volume. The switch is actuated by the arm of the microphone, as already explained.

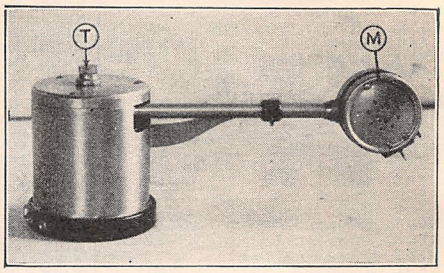


Fig. 1 An electrical reproducer for phonographs, employing a microphone (M) as the "pick-up," which replaces the sound box. T is the volume control.

It is apparent that the output terminals of this device can be connected to an audio-frequency power amplifier instead of a loud speaker, if greater volume than the instrument will produce is desired, but volume slightly in excess of that produced by the average phonograph can be expected when the device is used, just as it is shown in Fig. 2. The prime advantage, of course, lies in the superior quality of reproduction obtained, particularly when the new type disc records are being played. The microphone on this device is capable of handling low-frequency notes, which the usual sound box cannot reproduce and pass on to the horn.

AN ELECTRO-MAGNETIC DEVICE

The electrical reproducing device shown in the illustration of Fig. 4 is nearer to being like the ones employed in the Electrola and Panatrope machines than the one formerly described. The "pick-up," A, is of the electro-magnetic type and not a microphone. The movement of the needle in the record groove in turn actuates an iron reed, which is situated within a coil placed in the field of a permanent magnet. Any movement of the reed alters the relative intensity of the magnetic field, thus generating a current in the coil. This current varies in direct accordance with the vibrations of the needle travelling in the record grooves. These small current variations, which amount to an exact electrical reproduction of the music recorded on the disc, are passed on to an audio-frequency amplifier and loud-speaker. The unit B in the illustration of Fig. 4 is the volume control and consists of a variable resistance and a fixed condenser. The plug C allows the arrangement to be used with the radio set, without changing any of the wiring. The illustration of Fig. 5 shows how it is done. The pick-up A is feeding the vibrating electrical currents into the volume control B, B feeds into C and C is plugged into the detector tube socket of the radio set shown, which incidentally has a three-stage resistance-coupled audio amplifier. The two radio-frequency tubes and the detector tube have been removed, the former

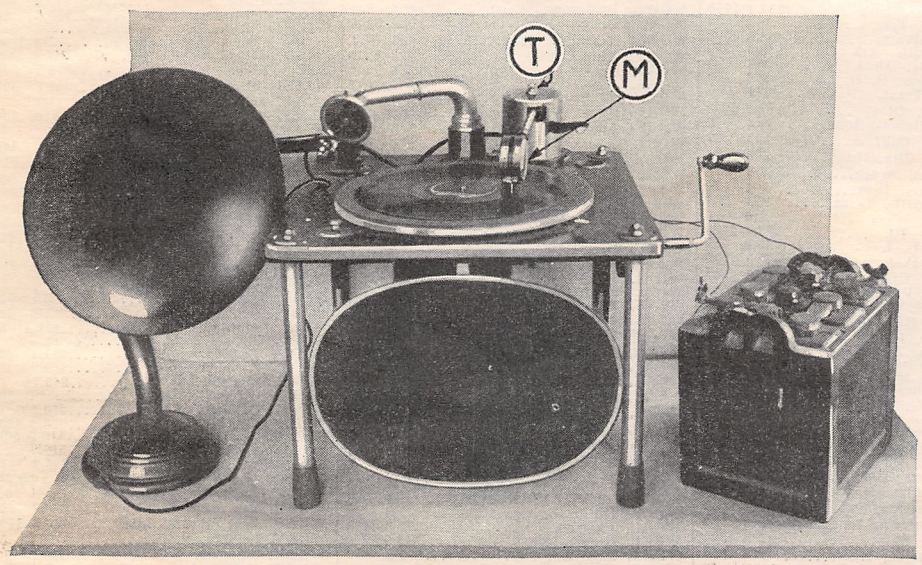


Fig. 2. The electrical reproducer shown in Fig. 1 connected up for operation. The only accessories required are a 6-volt storage battery and a loud-speaker. If the reproducer is used with an audio amplifier the storage battery should be replaced by a 1½-volt dry cell.

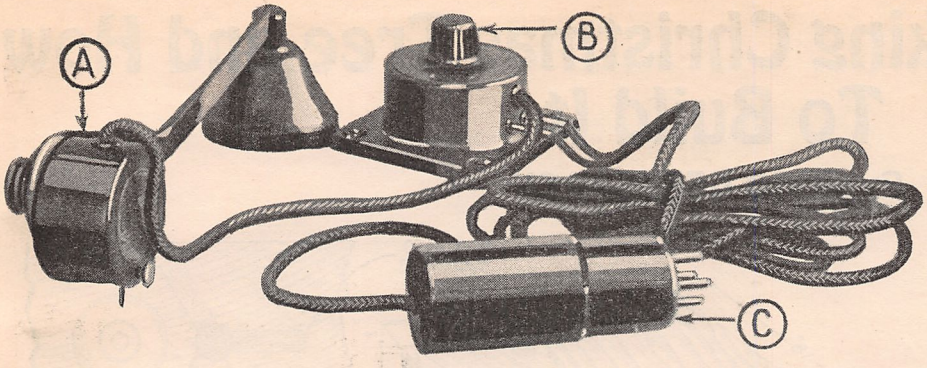


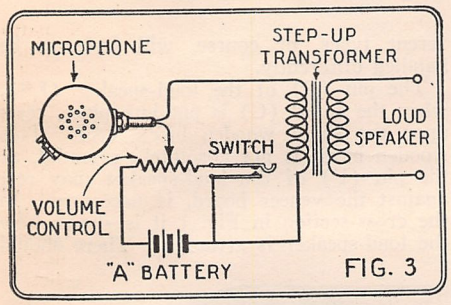
Fig. 4. Complete pick-up device of the electro-magnetic type. A is the pick-up, which replaces the phonograph sound box; B, the volume control and C, a plug which allows the use of the device in conjunction with the A.F. amplifier in any type receiving set. The plug is inserted in the detector tube socket.

Photo courtesy of David Grimes, Inc.

because they are not required and the latter to allow for the insertion of the plug, C. It is clear that the currents from A are passed through the audio amplifier and greatly amplified before reaching the loud-speaker.

Though the "A," "B" and "C" battery connections to the radio set are not shown in the illustration, it is understood that the radio set should remain as connected for regular operation with all the batteries connected and the filament switch turned on.

The circuit diagram of the device is shown



The circuit diagram of the electrical reproducer shown in the illustration, Fig. 1.

in Fig. 6. The blocking condenser, which is inside the volume control case, is placed in the circuit so that the "B" battery current, which would normally operate the detector tube, cannot reach the pick-up, which uses no current. The pick-up generates its own current by virtue of the movement of the iron reed in the field of the magnet.

REPRODUCTION OF MUSIC EXCELLENT

This electrical reproducer will offer perfect reproduction of record music, as evidenced if the cords from plug C are removed from the small jacks on the volume control case and a pair of headphones connected in. In full operation, any distortion that might be present, can be traced to the audio-frequency amplifier, or possibly the loud-speaker in use.

The pick-up A of this unit is designed to fit the tone arm of most types of phonographs. However, a special arm, shown in both illustrations of this unit, can be had, in the event that the pick-up will not fit the tone arm. The use of this separate arm also leaves the tone arm of the phonograph free to be used with a loud-speaker unit if desired.

MAKING YOUR OWN PICK-UP

Those who are mechanically inclined should experience no difficulty in making an excellent pick-up from a Type C Baldwin headphone, or any other similar unit of the balanced-armature type with a direct connection to the diaphragm. The diaphragm can be mica, as in the Baldwin unit, or metal, but for our purpose one with a mica diaphragm is most suitable as there is inclined to be less damping.

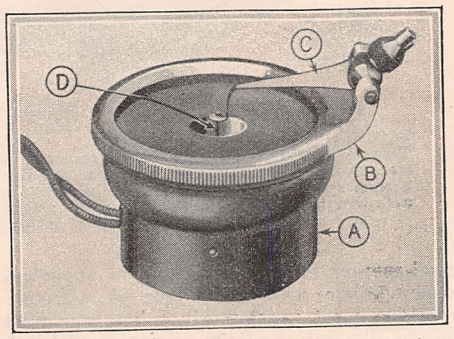
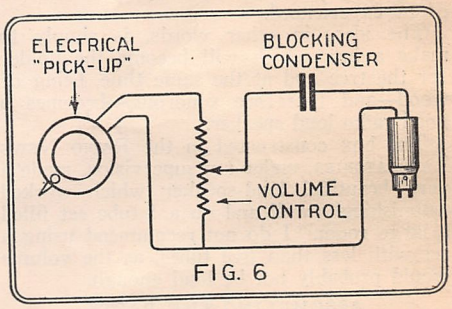


Fig. 8. A home-constructed pick-up of the electro-magnetic type. A is a Baldwin type-C headphone; B, a Pathé sound-box, C, is the stylus arm and D the connecting link.

The sketch of Fig. 7 gives all the necessary details for the construction of the device. The fitting for the tone arm is taken off the sound box and screwed on the bottom of the case of the unit. The sound box is screwed to the cap of the unit by drilling two holes through the cap in line with the threaded holes on the sound box, where the tone arm fitting was formerly fastened. The mica diaphragm of the sound box should be removed as it is not to be a part of the construction. If it is left on, there will be too much damping of the actuating units; the damping introduced by the mica diaphragm of the Baldwin unit being sufficient.

The end of the sound box stylus is linked to the connecting rod of the unit by a section of a steel sewing needle, this being soldered to both the stylus arm and the screw, which fastens the connecting rod to the mica diaphragm. A small soldering iron with a sharp point should be used for this job. The two screws fastening the sound box to the cap of the unit will have to be of the flat-headed type and the holes in the cap countersunk, as the mica diaphragm is perilously close to the cap. Round-head screws can be used if a washer is placed between the cap and the diaphragm, so that the cap cannot be screwed down all the way. In this case the length of the steel connecting needle will have to be increased.

If the sound box employed is of sufficient diameter, the cap of the unit can be dispensed with and the two bound together with friction tape or otherwise fastened with brass strips screwed to the case and sound box. In this case it should be possible to get the mica diaphragm of the unit on the same level as held by the diaphragm of the sound box. The end of the stylus arm can then be connected directly to the small terminal cap of the drive rod in the center of the unit diaphragm and still maintain its original position. This does away with the steel needle.



Wiring diagram of the complete pick-up device shown in Fig. 4.

Any number of different arrangements will suggest themselves and the manner of construction will depend a great deal upon the

(*Continued on page* 738)

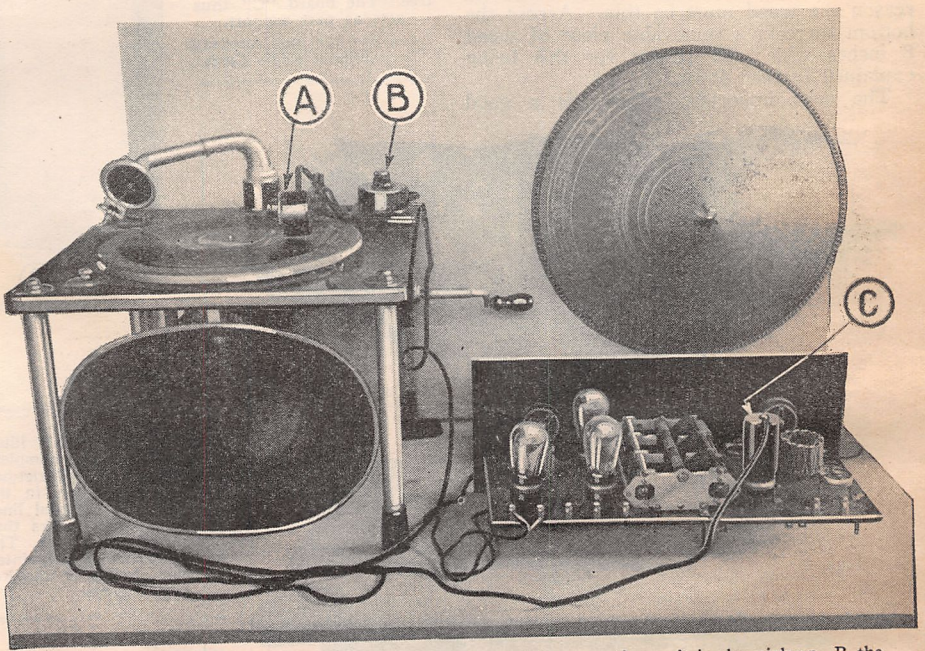


Fig. 5. The pick-up device shown in Fig. 4, connected for operation. A is the pick-up, B the volume control and C the plug, shown inserted in the detector tube socket of the receiver.

The Loud-Speaking Christmas Tree and How To Build It

By HUGO GERNSBACK

A CHRISTMAS tree and music are almost synonymous. A Christmas tree without music is like a rose without a scent! The real Yuletide spirit requires music for its expression; so the thought of combining the radio and the Christmas tree seems astonishingly self-evident, and I have been wondering for some years why it has not been more universal. Of course we have the radio and its loud-speaker, perhaps in the same room with the tree, or we have the phonograph or other music galore; but I believe the combination of the Christmas tree and the radio is somewhat novel and should appeal to many. Moreover, it is simple to accomplish.

Not only that, but the idea described here really kills two birds with one stone. First, you make your Christmas tree musical; and second, at the same time, you provide the necessary base for the tree. This you must have anyway, and you do away with a cause for real vexation, which you have so often experienced.

The idea, in other words, is simply to make a box which will become the holder for the tree and at the same time, being of wood—and therefore sonorous,—becomes a good radio loud speaker.

The box constructed in the RADIO NEWS LABORATORIES, under my supervision, made a very beautiful loud-speaker which worked astonishingly well and on a 5-tube set filled a large room. I do not recommend using a set with less than five tubes, as the volume would probably not be loud enough.

ASSEMBLING THE PARTS

The illustrations are almost self-explanatory, but a few words of explanation may not be amiss. The box shown in Fig. 1, can be made out of almost any sort of wood, and the dimensions as given are about right. The entire box is made out of lumber 1 inch thick, with the exception of the top board, which may be some veneer wood ¼-inch thick, or even less. This receives the sound vibrations, transmitting them to the surrounding air, and for that reason the wood must be thin. Across the bottom there is a removable piece of wood 8 inches wide; the reason for this being explained further down.

The next important adjunct is a good loud-speaker unit. Those now in vogue on cone speakers are the best for this purpose. working most satisfactorily. The one used in our illustration of the original model is a unit which was originally designed to be fastened to a piano sounding-board, in order to make the radio music come directly from the sounding board of the piano. As shown in Fig. 3, this loud-speaker unit is fastened against the removable board. Units of different types, of course, will have to be handled differently.

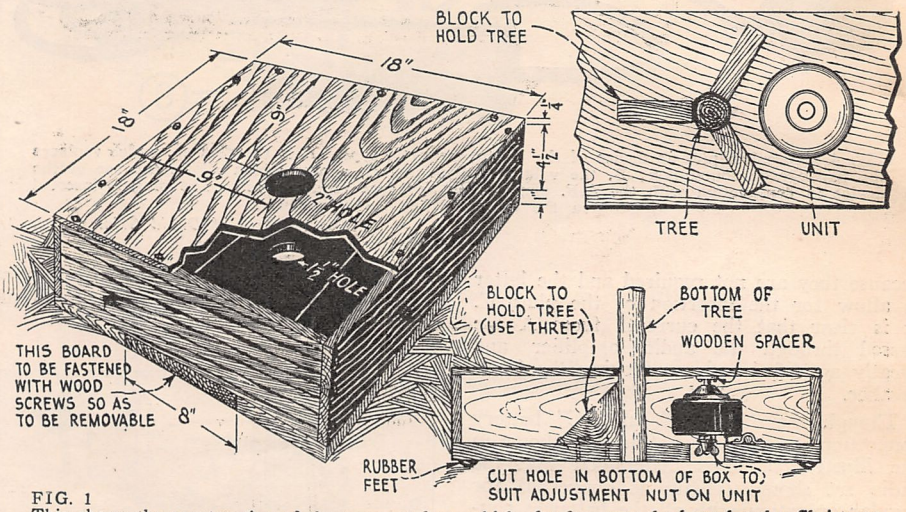


FIG. 1
This shows the construction of the resonant box, which also becomes the base for the Christmas tree. Note particularly that the top of the box must be of thin veneer wood. The heavy wooden bottom strip is equipped with three blocks to hold the tree. Cut these pieces to fit the tree. Also note that the loud-speaker unit must be placed in correct relation to the resonant top part of the box. An adjusting screw is provided to regulate the unit for best results.

The pin (P) of the loud-speaker (LS), when the board (C) is put into place, rests upon the small wooden block (A). This wooden block is not absolutely essential, as the pin (P) of the loud-speaker may rest against the veneer board, if necessary. In the cross-section in Fig. 1 it is shown how the loud-speaker is arranged. There should also be a hole for adjusting the loud-speaker, which is important. In this combination a *unit that cannot be adjusted is useless;* as it would be almost impossible to get the right tension between the vibrating pin and the veneer board unless you can puncture the veneer board itself and provide some adjusting means on this. This could, perhaps, be done with a machine screw; and by moving this back and forth the correct adjustment could be obtained. I do not recommend this method.

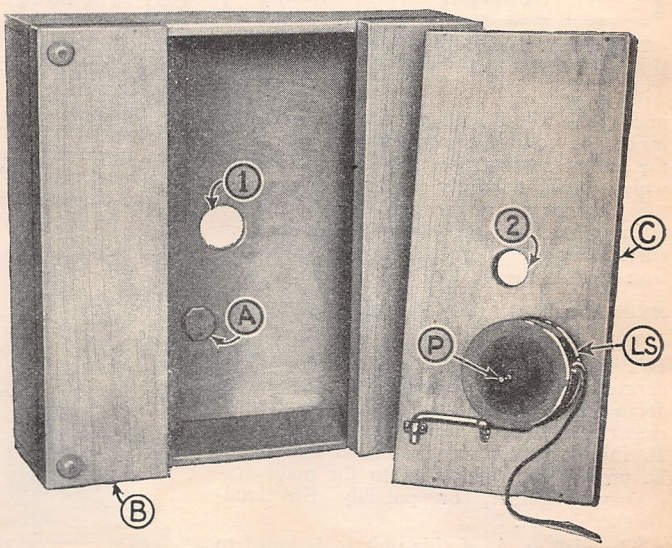


Fig. 3 (Right). A photograph of the loud-speaker box as constructed in Radio News Laboratories. Note particularly that hole 1 must be large enough so the wood does not touch the tree. This would muffle the sounds. Hole 2 is cut just large enough to take the tree. The board "C" thus acts as part support.
Loud speaker unit courtesy International Radio Corp.

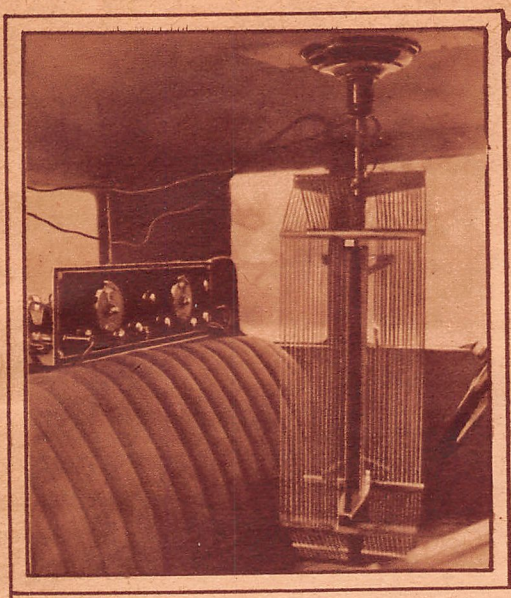
Fig. 2 (Left). This illustration shows the complete assembly of the Christmas tree after insertion in the resonant box. Dotted lines show the three blocks that help support the tree. The box is decorated or painted to suit builder's requirements.

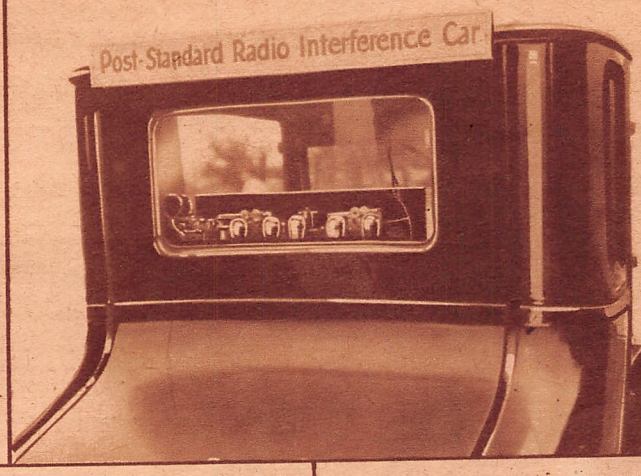
SETTING UP THE TREE

Once the loud-speaker is adjusted it needs

(*Continued on page 764*)

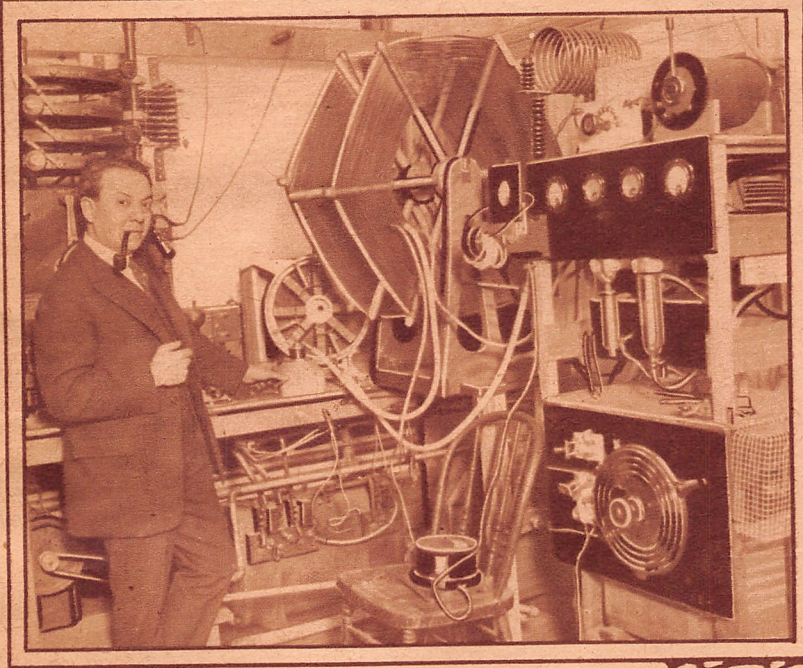
Advancement in Radio





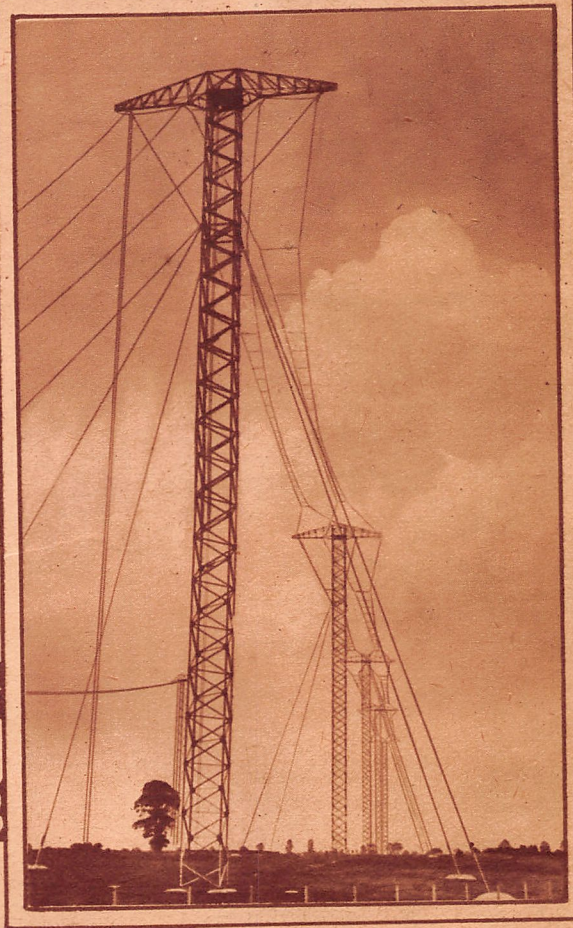
Sources of radio interference in Syracuse, N. Y., are investigated with the aid of this car, supplied by a newspaper of the city, which patrols the streets every evening. The loop shown in the view at the left is used to detect the source of any alternating-current hum, which is tracked down at once by an experienced lineman.

© *Syracuse Post-Standard.*



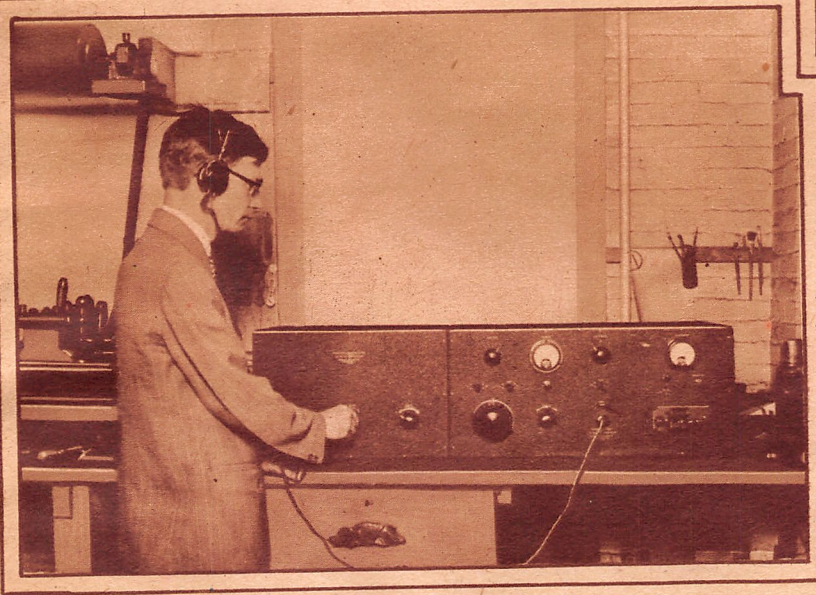
The high voltages and increasing power used in transmission require apparatus especially built to withstand them. In this picture William Dubilier is shown in his laboratory, where research work is being done on the design of condensers adapted especially to high-frequency (short-wavelength) work. The 10-kilowatt transmitter shown here is equipped for either long or short waves.

© *Herbert Photos, Inc.*



Above are the radio towers of the new beam-transmission station which has just been erected at North Petherton, Somerset (England), especially for communication with America. The purpose of the peculiarly shaped antenna is to permit varying the direction of the "beam." The waves may be transmitted in any desired direction, thereby greatly increasing their range with a given power, and more readily overcoming interference and fading.

© *World Wide Photos.*



At the left is shown Paul Sollenberger of the United States Naval Observatory with the receiver which he has designed for work in the determination of longitudes. Observations will begin at San Diego, Calif. By the reception of radio signals from seven powerful transmitters at distant points throughout the world, the differences in longitude can be determined within a few feet.

© *Harris & Ewing.*

The Place of Radio In Home Decoration

Art and Radio Have Become Partners in the Home

By GOLDA M. GOLDMAN

This Chippendale (above) surrounded by harmonious decorations, shows how attractive a room may be made by a cabinet worthy of the finest radio.
Photo by courtesy of Stymus, New York.

THE time has so far passed for considering radio in the light of a plaything, with which men of the family regale their leisure hours instead of playing billiards, that radio has come into its own as a paramount factor in home decoration. This means that the ladies have decided that the apparatus, which has become so definitely a part of their household equipment, must also be an attractive part of their furnishings.

In its earliest stages radio, like a very long-legged and unsteady young colt, was anything but beautiful. It was something which made the living room look like the garage just after the Ford has been taken apart. Once put together it was not much better, comprising as it did at least three bulky units. Art, however, is seldom far behind science these days, as the two former rivals have discovered that they make excellent partners.

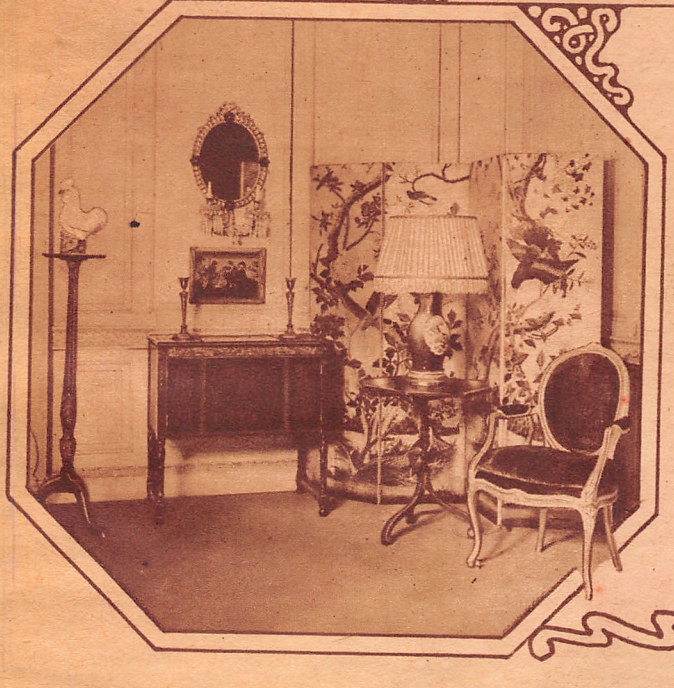
TASTE IN CABINET WORK

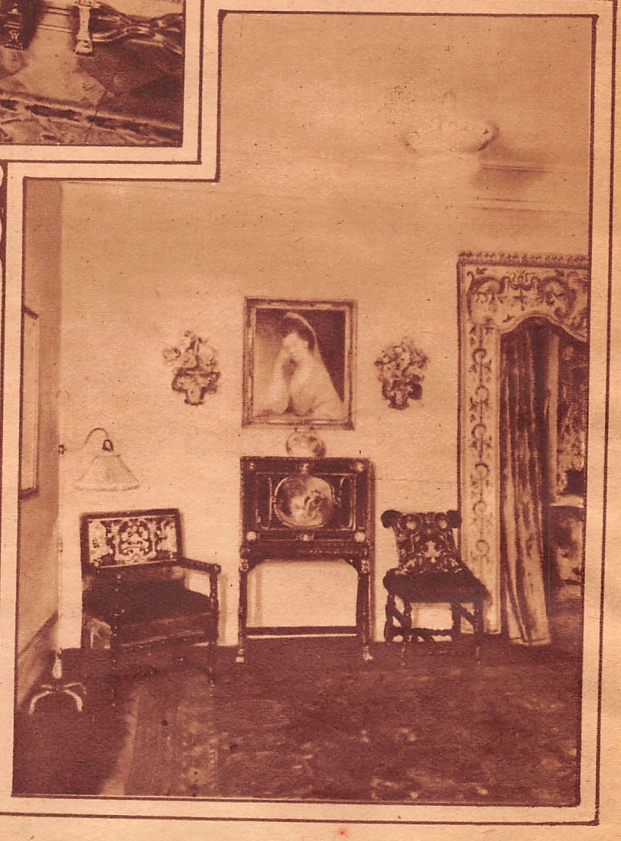
So it is that if you go to buy a radio set to-day you are presented with an amazing choice of cabinets, and the type which you purchase for your home should be, not at variance with the remainder of your decorative scheme, but an acquisition harmonizing with it in every way. The purchaser is not limited in the least; consult only three things: your pocketbook, your taste, and the room in which you intend to install this latest article of furniture.

In the more spacious drawing room there is ample room for a cabinet (right) such as graced an old Italian palace. Again, a suitable background is provided.
Photo by courtesy of F. Huber Co.

Yet, under modern conditions, a small corner or tiny wall space is often all that is available. The delicate cabinet below answers such a problem.
Photo by courtesy of Wm. Baumgarten & Co.

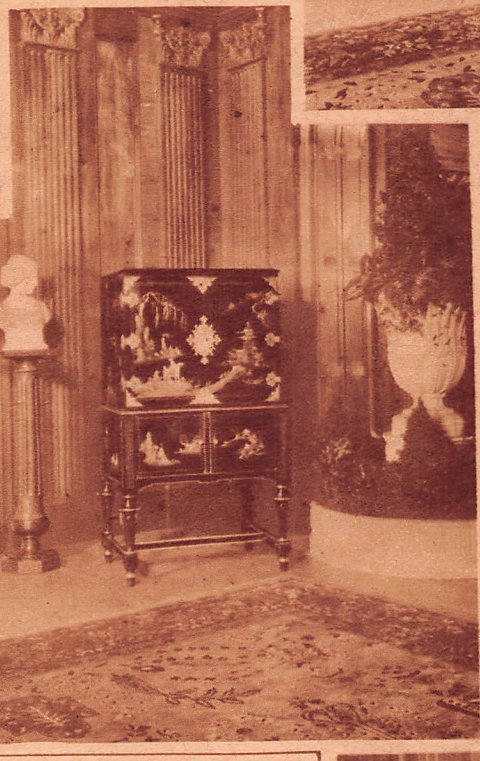
A dainty cabinet, such as that shown in the lower right-hand corner, is a charming addition to any drawing room or music room. This one is painted like a miniature.
Photo by courtesy of W. J. Sloane & Co.





The stately cabinet at the left, an Adam inspiration from the times of the robust Cardinal Wolsey, is decorated in Japanese period. It houses not only the receiver with its power supply, but a loudspeaker as well, which is built into its upper portion.

At the right, a slightly smaller Louis Quatorze design, in solid walnut throughout. The slight change in the setting brings it into perfect keeping with the console which is the keynote of the picture. The creation of an interior in which every object shall find its natural place is a labor of taste, but the result seems inevitable.



In contrast to that above, the Louis XIV cabinet at the left is in the Japanese finish and genre which stresses color as well as form. Another answer to the same problem—the treatment of radio with dignity in a fine room.

Below, Japanese art in a Marie Louise cabinet, the center of a decorative composition in another key. This console, smaller than the others on this page, is equally complete in its appointments.

Photos on this page by courtesy of Knickerbocker Talking Machine Co

Is it a question of size? You will find your grandmother's highboy accurately reproduced, large enough to monopolize an entire wall space; or you may choose from an ample variety of console types one which will either take the place of your discarded victrola, or old-fashioned small desk, or which may be used in the foyer hall with a long mirror, quite out of your way, and yet easily accessible when wanted.

Is it a question of color? You may liven up your dull library with a gorgeous affair of Chinese lacquer, or set a dainty painted cabinet against the wall in your tiny living-room, much as you might use a picture or a tapestry-backed chair. Or keep, if you will, your duller tones of oak or walnut or mahogany, choosing from myriad lovely inlaid and beautifully-grained woods, which glow like the satins of lovely gowns among your more sombre furniture.

AMPLE FIELD FOR CHOICE

As said before, it is only a question of how much you care to spend. The leading decorators have converted their finest antiques into cabinets for this marvel of the age, and their window and showrooms place these for you in the midst of exquisite drapes and screens, cushions and paintings. But you need not feel that only through spending a fortune can you add thus to the pleasure of your home. Stock models at reasonable prices, and carrying out the same delicacy of line and care of color, are to be found in every large radio, music or furniture shop. There is today within the means of every lover of radio some type of artistic cabinet, which will add to instead of detract from the charm of the home, and the pleasure of the listening-in hour.

UTILIZING YOUR OWN HEIRLOOM

More than anything else which they have done, however, is the fact that in creating or converting these unusually attractive cabinets for the housing of the radio set, the decorators and manufacturers have shown the home mechanic what he can do with his own set. Why build with much labor a radio which when finished is merely a piece of mechanism to be set awkwardly upon a table, disfiguring an otherwise tasteful environment? In practically every home there is some lovely article of furniture, which might well be designated as the home for this new set.

If you are so gifted that you can build yourself a radio worthy of the article of furniture which you are going to adapt in this way, why not remove the record racks from your victrola and use that space? If the family boasts of an heirloom, of a high-boy or a low-boy, too precious to be thrown away, yet which apparently has outlived its usefulness, you possess exactly the type of thing which would sell for several hundred dollars in a fine shop. A little renovating of the interior, and you are provided with more than enough space in which to house all kinds of batteries and extra apparatus.

These articles have been chosen in most cases, because they were in harmony with the furnishings of the home. Study the type of thing being done in ready-made cabinets and sets, and you will find in many instances that you have at hand the very thing you want, thereby saving the additional expense of a new piece of furniture, and restoring to usefulness, and therefore to new beauty, a companion already endeared to the family heart through long usage.

Speaking Over the Radio

By CHARLES D. ISAACSON, Program Director, WRNY

ONLY the other day Hugo Gernsback, in his Monday night series at WRNY, delivered an eloquent talk in which he said that speaking on the radio is not what it should be. In fact, because of technical difficulties, which make hearing the speeches a task, Mr. Gernsback feels that the instructional part of radio broadcasting had better wait, or rather stay in the background.

Well, right away, I am going to take the chance of never meeting you again in the pages of RADIO NEWS, by differing somewhat with the editor. And, if he takes his charges too seriously and refuses to talk any more on Monday nights at WRNY, we are going to have to fill in our program the most serious and difficult hole, which has faced me since I joined the RADIO NEWS Magazine station over a year ago. And if you please, that is not blarney.

Hugo Gernsback is interesting to me, because he gives me the most enlightening point of view on fascinating subjects, which arouses my imagination—gives me new vision for my work. I am just an example of others. To listen to music only on Monday nights would, with all my love for music, drive me nearly crazy. I must have something else, something to introduce variety into the mental bill of fare.

Please do not think I am advocating all-speech programs. That would never do, either.

My doctrine is seventy-five per cent. musical entertainment (of all kinds) fifteen per cent. of other entertainment, and ten per cent. of entertaining information or educational matter.

Deliver me from the hour or half-hour speeches of some people—even the most famous men and women! "Radio," as Hugo Gernsback pointed out, "calls for non-visual attention, and hence is not capable of

(*Continued on page 747*)

Josefa Chekova
Who brings the songs of old Bohemia to WRNY's great audience, in the picturesque Czech costume.

Carl Schlegel
For thirteen years a baritone of the Metropolitan Opera Co., was a recent soloist at WRNY.

Lina Abarbanell
Operatic star of many successes, was a welcome number in a recent Edison Hour program at WRNY.

Louis Stillman
The eminent instructor of many fine pianists, is a regular guest on WRNY musical programs.

Clarence Derwent
Star of "The House of Ussher," and one of WRNY's theatrical visitors.

Helen Strype and Jack Blue
Two clever entertainers who put on an interesting number at WRNY. (Ensemble by the artist.)

Paul Largy
A popular tenor who appears in WRNY's roster of visiting soloists, and a favorite number.

Judith Roth
Recently embarked upon the sea of matrimony. Her fine voice is not, however, lost to WRNY listeners.

Elsa Clement
The children's entertainer, is a real treat for the kiddies who hear her songs from WRNY.

Irene Kuhn
Who told of her travels in WRNY's symposium, was the first woman to broadcast in old China.

Ralph Rose, Jr.
Though young, as you may see, he is a brilliant violinist, and a welcome addition to WRNY programs.

The Edison Ensemble at WRNY's Microphone
This is the group of splendid musicians who make each Tuesday evening's Edison Hour an event you look forward to with pleasurable anticipation, and one which draws thousands of letters of applause.

Birdie Reeve and Her Movie Friends
She is master, not only of the typewriter, but of the dictionary. Did you hear her at WRNY?

Radio for All Ages

Young Mr. Daniel Roberts appeared thus as "Mr. Radio Man" in the children's parade this year at Asbury Park, N. J., and won the vote of radio fans. Another prize-winner is shown at the right; these bright little twins, Joyce and Kathleen Lewis, though but two years old, are setting an excellent example for their elders, who will profit by the morning exercises that are broadcast daily.

© *Herbert Photos, Inc.*

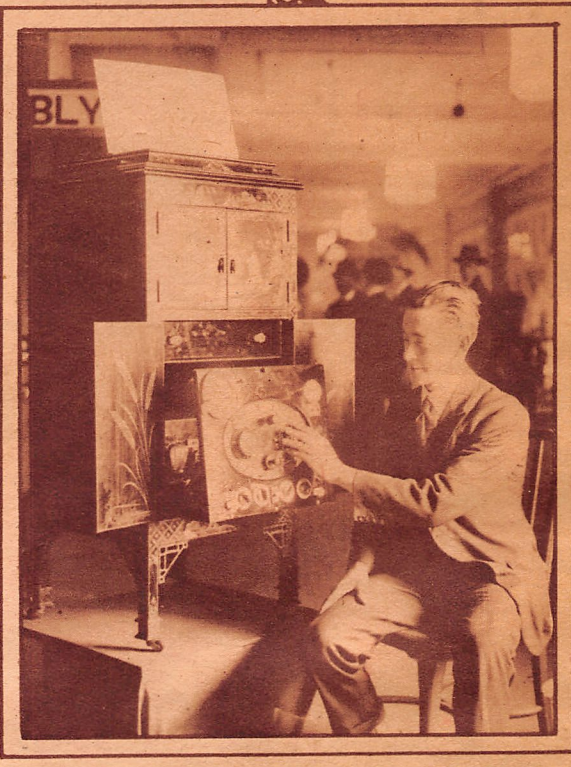
Above is Miss May Mudge, "Miss Boston" of the national beauty contest, with one of the amateur exhibits at the Boston Radio Show. The good ship "Radio Rover" is not dismayed by sea waves, radio waves or marcel waves.

You will not in the future have to watch the clock for the hour of that program you are bound to hear. This invention of Percy Emsley's incorporates a time switch, clock-controlled, which is set to turn on the set and speaker at the appointed time.

© *P. & A.*

How would you like to have a ten-tube portable (?) set incorporating such big fellows as Miss Betty Haley is here seen holding? This is a model shown at the Boston Radio Show but we are not informed that its functioning was demonstrated.

© *Wide World*



A Christmas Gift of Happiness

Radio Will Make Life Brighter for the Sick and Infirm

YOU

who have an old radio outfit that you cannot use, and you who have a radio outfit that perhaps is obsolete now, and should be replaced by a new and up-to-date receiver, can help to make some unfortunate person happy by giving the old set to a needy shut-in.

Christmas is almost here, and if you wish to do a good deed, now is the time.

RADIO NEWS, in its November issue, asked for the co-operation of its readers in bringing sunshine into the lives of shut-ins—those unfortunates whom age or illness confines to their often cheerless homes. To these poor people the possession of a radio set, with the companionship and entertainment it will bring, would be like the opening of the gates of Paradise. As these lines are written, this appeal has just been delivered to our readers; but we have no doubt that within the next few weeks their generosity will respond in ample measure.

The Christmas season is fast approaching; the time when good will reigns, and all who have enjoyed the blessings of good fortune and prosperity seek to share with others. There is then a spirit of kindness in the air, of desire to lift the burdens too heavy for their bearers. It is the purpose of this little article to tell the story of those who cannot speak for themselves, and to put it in the power of our readers to bestow blessings upon those whose need is greatest.

THE SHUT-INS

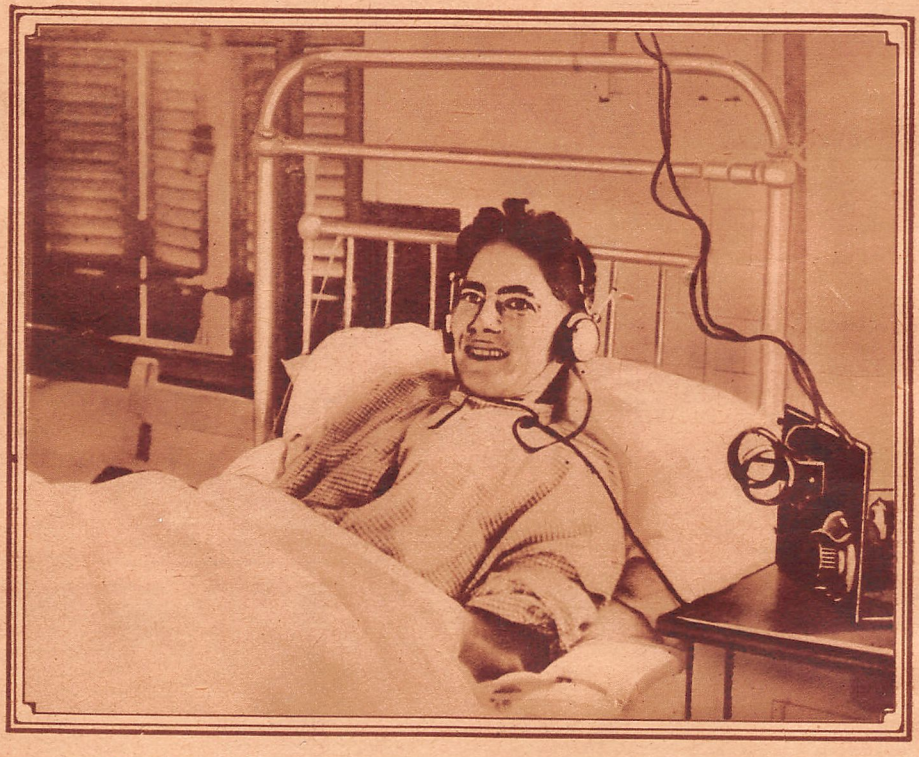
The reader of these lines, unless exceptionally fortunate, has passed many weary hours upon a sickbed. Even though you were fortunate enough to escape the pains of severe illness, you found confinement almost insupportable. The hours seemed to multiply into years; you welcomed every diversion, you longed for companionship, for the sound of a voice, for anything that would while away the dreadful days. Now imagine to yourself that you have been told, with a certainty forbidding you to hope, that your room will be your prison until your dying day. There are many, far too many, in such a case.

You can help them! You cannot say to them "Rise up and walk," but you can set free their minds from the bondage of old age, illness and poverty, for many happy hours. You can help them through the cheering message of *Radio*. Had it done nothing else for the world, the help that it has brought to the sick and feeble would justify every effort of mind and hand that it has cost.

On behalf of those who are poor, with few or no friends, infirm and suffering, we ask your consideration. Their bread has been secured by their own utmost exertions, or bestowed by the hand of charity, but there is a hunger of the mind and soul which you can help to feed through the gift of a new interest in life.

HOW YOU CAN HELP

If you can make the gift of a radio receiving set, even the simplest, to a shut-in, you will be doing a good deed that will earn heartfelt gratitude. If you have not such a sufferer among your own immediate neighbors, we will be glad to tell you where your benevolence will find a worthy objective. The little stories of real life which we are printing in each issue of RADIO NEWS are true: they are vouched for by the charitable organizations, who are already helping these good people to find the necessities of existence. There are many more to come.



If you can imagine, even to a small extent, the pleasure a radio receiver will give to some bedridden person, you will be only too glad to give one of your discarded sets to an invalid.

Have you a receiver you have discarded for one more pretentious; a battery in good order, a speaker, headphones, or other accessories still serviceable? Write to the Editorial Department of RADIO NEWS and tell us what you can offer, so that directions for its disposal may be sent you. The cases described in our November issue are those of persons in New York, but many other stories have been received from other cities throughout the country; so that heavy apparatus should not, in most cases, be forwarded to this office. All gifts will be bestowed under the supervision of the leading philanthropic organizations in their respective localities; and will be acknowledged in these columns.

Do not let that good radio equipment gather dust in a corner, when it could be creating happiness for those who need it so much. Get it out and start it on an errand of mercy. *Do It Now!*

Case No. 12

The Bennett family have had more than their share of afflictions and it would take more philosophy than most of us have to endure them. There were several promising girls in the family but none of them as bright as the oldest, Maude, who won honors in high school and a scholarship in a University. Through college she kept up her record, but toward the end of her Senior year she was bothered with a headache, which never left; until finally there had to be an operation in which a brain tumor was removed. Since then Maude has been an invalid. Unfortunately her father is in a sanatorium struggling with a disease from which he probably will not recover. Another daughter, Carrie, is run down and in danger of tuberculosis, and seventeen year old Bess has an injured spine and is now confined to her room. All Mrs. Bennett's thoughts are directed toward keeping the family going financially. She has little time in which to cheer up Carrie, who is sure she is going to die, or distract Bess' mind from the pain in her back, or stimulate Maude's mind to come back to her former interests or brilliant performances. What might not a radio set do here! (Cleveland)

Case No. 13

Old John is 79 years old, too frail to work. Mary, aged 76, has in her time been hard-working, thrifty and independent. A third stroke of paralysis has now leveled her to her bed, from which she lamely limps with great pain to tidy up her small cottage. The only living relative is their son, Harry, now 35 years old and almost totally blind—he can just distinguish daylight from dark on long winter days. He it is who prepares the meals for the old folks and attends to their few frugal wants. There are but few rays of sunshine and hope in this impoverished home—and yet all three of these people are of good cheer. Their home is filled with a real spirit of religion, as they thank God "for their many blessings." If only one of these blessings might be a radio set. (Cleveland)

Case No. 14

Mrs. Warner, a frail mother, spends all her efforts in looking after her seven children, who have been deserted by their father. The only one of the children old enough to help Mrs. Warner in this difficult job of being breadwinner and mother to so many youngsters, is eighteen year old Mildred. It is struggle enough for the two of them to provide the very means of existence for the other six, without having much

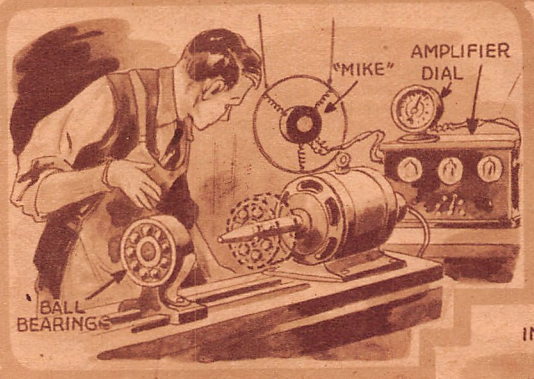
(*Continued on page* 753)

Recent Topics of Radio Interest Illustrated

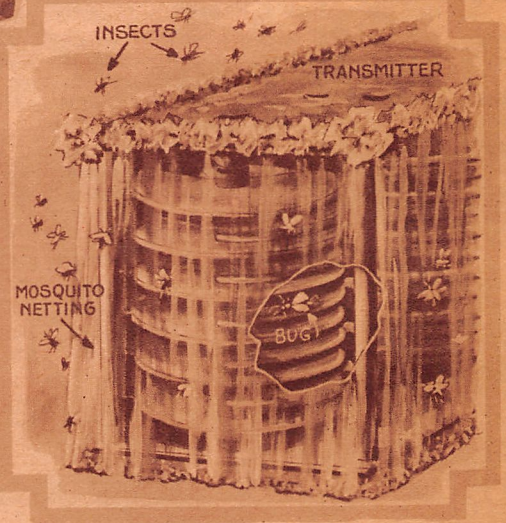
By GEORGE WALL

Charles Kellogg, "the man with the birdlike voice," recently accomplished the feat of blowing out a light in Berkeley, Calif., from San Francisco, twelve miles away and across the bay. This was accomplished, not by unusually strong breath, but by maintaining a sustained high note until the vibrating flame was shaken and extinguished. The principle has been known for seventy years, but this is the first radio demonstration.

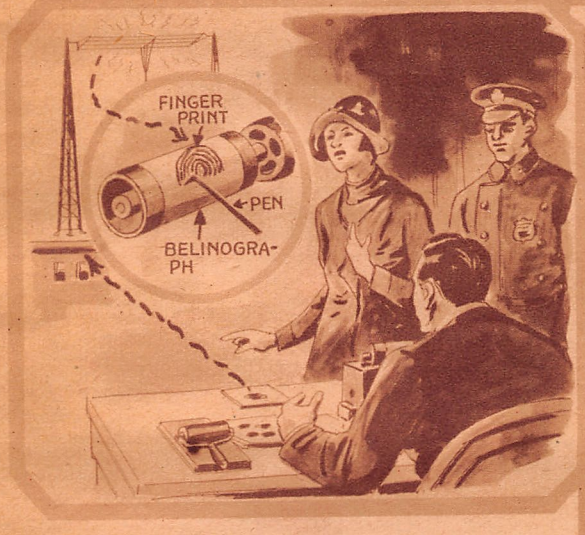
Those who listened to broadcasts of the Dempsey-Tunney fight got more of the details, from their easy chairs at home, than did many of the purchasers of "ringside" seats. However, J. R. Poppele, a radio engineer, learning in time the location of his seat, took a portable one-tuber with him and was able to hear as well as see what was going on. As a matter of fact, he was more of a center of interest than our artist has indicated, being surrounded by anxious neighbors to whom he relayed the announcer's description.



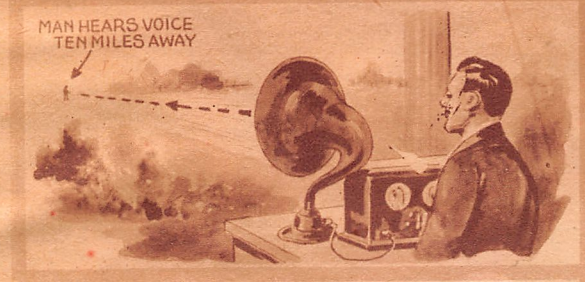
It has long been the custom of engineers to depend to a large extent upon the sense of hearing to determine how smoothly a mechanism is running. The use of radio amplification to test the smoothness of bearings at high speed has lately been perfected. The slightest irregularity in the machined parts is instantly audible. 50,000 ball bearings can thus be tested daily.



The big transmitter of KDKA is tastefully draped in this manner, not altogether for aesthetic reasons. It is necessary to keep insects out of the fields of the big condensers. The blundering moth who flutters into the high-potential area not only comes to immediate destruction—he is used to that—but by his brief presence causes interference with the program, which is more important. So now the apparatus is screened with very fine netting.



The time has gone by when the crook had only to don a pair of false whiskers and move to the next town to elude the leaden pursuit of justice. French criminologists first devised the "Bertillon" method of identification; and now we have direct radio transmission of fingerprints between the police headquarters in the cities of France. Identification by this method is certain, and more easy than the former system of telegraphing code.



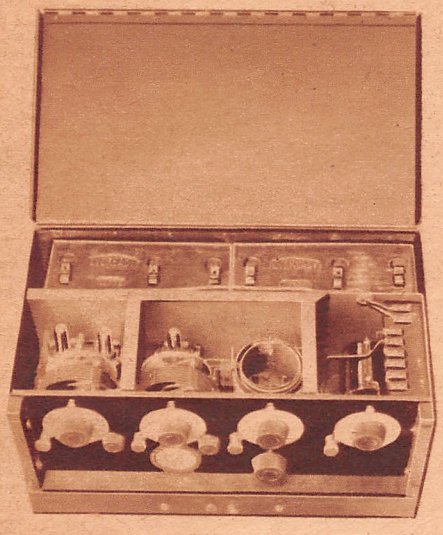
Super-broadcast amplification is promised through the use of a new tube, announces A. J. Musselman, the inventor. Through the use of a suitable circuit and connections, it is predicted that it will be possible to hear the human voice clearly ten miles away from the reproducer.

"Swinging" is particularly annoying when you are listening to a fine program, but it can seldom be traced to so tangible a cause as was recently discovered. Investigators of mysterious interference with radio sets in lower Manhattan (New York City) a few evenings ago could hardly believe their eyes when they found that a large ape was using the aerials for his daily dozen. He was soon restored to his owner with the suggestion that his education be further advanced before allowing him to study radio.

Radio In the Railroad Yards

Saves Time in Freight Car Switching

By S. R. WINTERS



This 4-tube receiver, tuned and then locked to the wavelength of the yard-master's transmitter, is placed in the engineer's cab.

THE switching engine, with clanging bell, races back and forth on a network of tracks; then, at intervals, it is seen tugging long trains of freight cars. Signals from a tower are flashed to the engineer, thus directing the movements of the engine, or maybe a flagman, hugging the rear freight cars, relays these signals to the engineman. This is a familiar scene at great railway terminals or at points where large cars of freight are routed over different transportation lines.

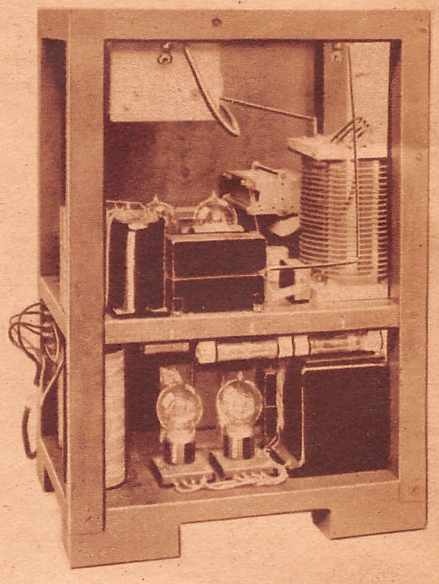
This age-old method of signaling shifting or switching engines, however, may be discarded in the future in favor of the radio telephone. Experimental tests conducted by the Bell Telephone Laboratories at a freight yard in Gibson, Indiana, proved successful in controlling the shifting of long lines of freight cars, communicating from a central control point to the engine by radio. In a measure, a radio antenna displaced the ordinary colored signal lights at the tower or the switchboard of the so-called "hump."

The tool box of the locomotive engineer contained a radio receiving set, but instead of listening to "Just a Cottage Small by a Waterfall" he heard such orders as "Slow down to two miles an hour." It was a four-tube set and it was connected to a loud-speaker located in the locomotive cab just above the head of the engineer. It was not necessary to tune the receiver—the controls were locked and the cover closed and fastened—and the engineman merely had to turn on or off the outfit. Green lights indicated that it was functioning properly; red lights warned that the vacuum tubes had burned out.

DESCRIPTION OF EQUIPMENT

Structurally this receiving set consisted of four vacuum tubes, deriving their power supply from batteries. The first tube acted as a radio-frequency amplifier in a tuned stage; the second tube functioned as a detector; the third served as an audio-frequency amplifier; and the fourth tube acted as a power amplifier to operate the loud-speaker. Difficulty was experienced in finding space for the antenna for the receiver; it being finally placed on the rear of the tender. It consisted of 150 feet of rubber-covered wire, wound around a form built of two-by-four timber.

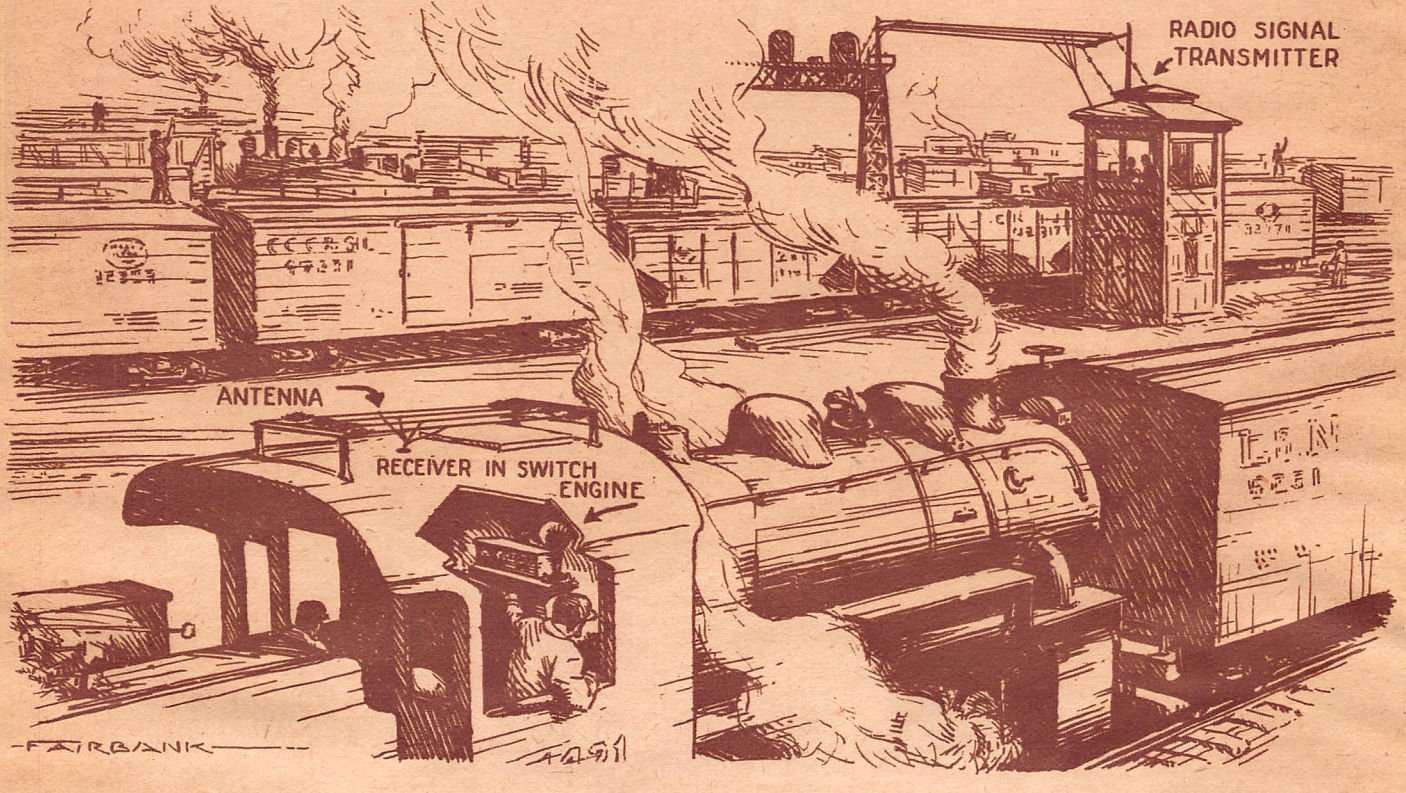
The transmitting set used in these novel tests was so conveniently arranged and modest in its power requirements that it could be plugged into a lamp socket. The truth is, in these freight-car signaling experiments the source of power was the 110-volt, 60-cycle supply—the current you might expect to find in any house-lighting circuit. Three dry-cell batteries were used in supplying energy to the microphone and the needed relays employed in this radio-signaling system. The transmitting equipment consisted of four 5-watt vacuum tubes. Two of the latter rectified the high-voltage alternating current, which was obtained from a transformer, and the other two tubes constituted the oscillator and modulator, respectively. The outfit closely resembled a broadcast transmitter, except that low power was used and it operated at short wavelengths.



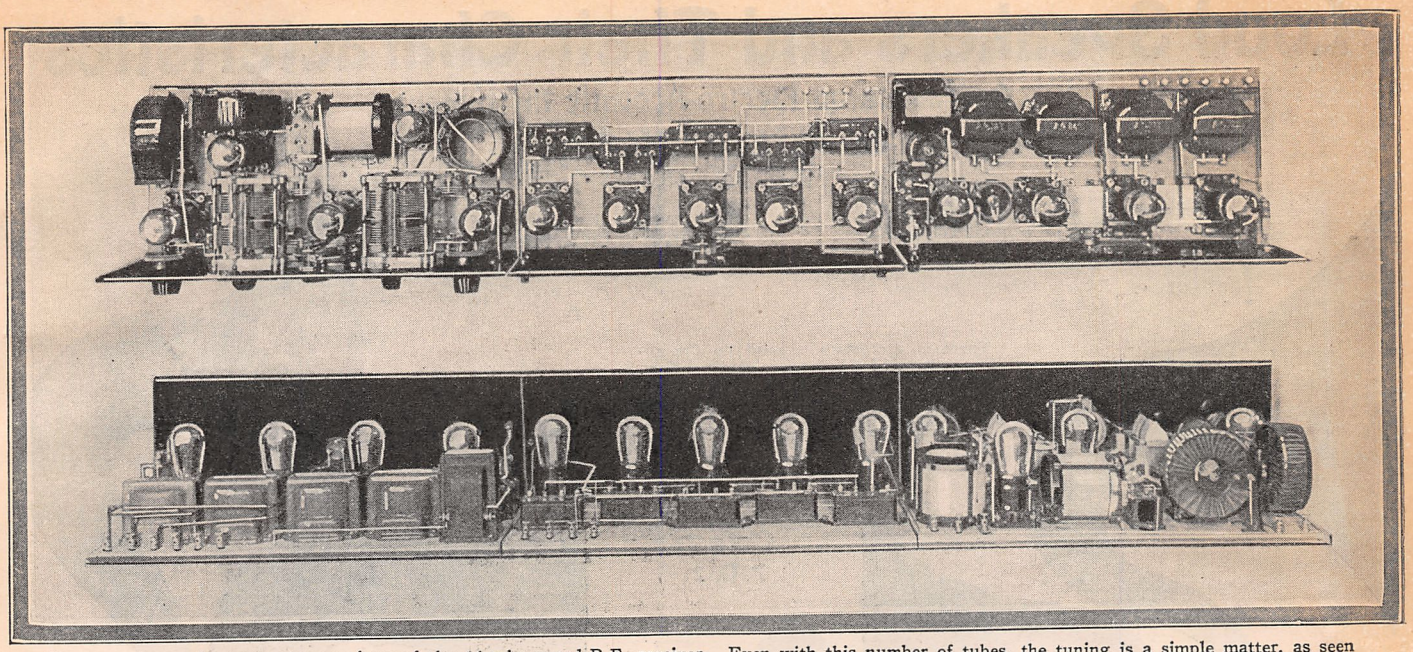
The four-tube radiotelephone transmitter, which is located in the switch tower.

The transmitting set was installed at the

(*Continued on page 690*)



Instead of signalling by means of lights from the tower to engineers, orders are transmitted by radiotelephony, making for greater speed, certainty and convenience all around.



Here are shown the top and rear views of the 14-tube tuned-R.F. receiver. Even with this number of tubes, the tuning is a simple matter, as seen from the panel view.

A 14-Tube Receiver

Ten Stages of R. F. Amplification Under Control!

By FRED A. JEWELL

THE construction of a fourteen-tube radio receiver for broadcast reception, that utilizes ten stages of cascade radio frequency amplification, a detector and three stages of audio frequency amplification, is not such a complicated job; but, to make it work, after it is built, in something like a fair degree of efficiency so that it will not require the services of a radio engineer to operate it, is another problem—especially so if quality of reproduction is to be retained.

Since the beginning of broadcasting of radio programs, a large number of radio fans in South America have been attempting to receive programs from the States in something like a decent manner. Practically all makes of sets have been tried. Also, numbers of special sets, that utilize all of the known circuits and equipment, have been built and tried out, but, up to the present time, no results of any importance have been obtained.

Mr. David G. Bricker, of Bolivia, a mine operator, was one of these fans; and after every trip that he made to the States he would take back with him a new set, hoping that he would have better luck next time. But only a slight improvement was made and he was still very far from the much desired goal. Therefore, in his firm determination to achieve the desired results, he wished on the writer a man-sized job, in the form of an order for the most powerful radio receiver that can be built under the present known theories of the science, regardless of cost. That part is easy, but, there is a catch in it. It has to be very simple in operation, with a minimum of controls. Also, it has to be non-critical, and very selective; but

(*Continued on page* 696)

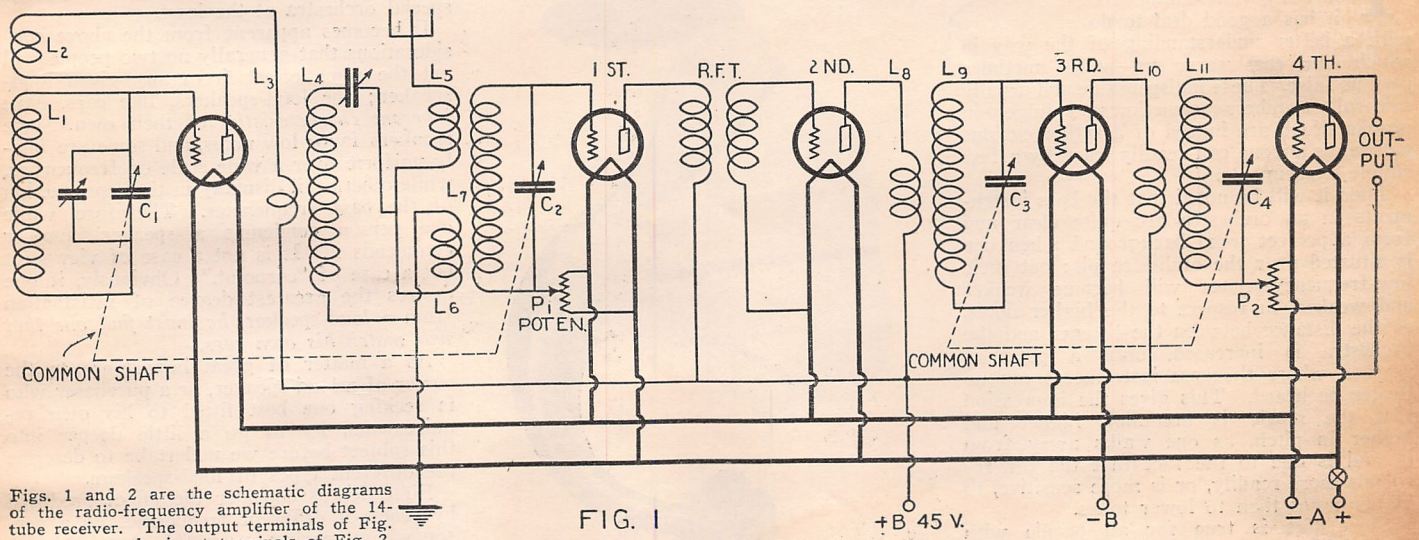


FIG. 1

Figs. 1 and 2 are the schematic diagrams of the radio-frequency amplifier of the 14-tube receiver. The output terminals of Fig. 1 connect to the input terminals of Fig. 2. The detector and A.F. circuits are conventional.

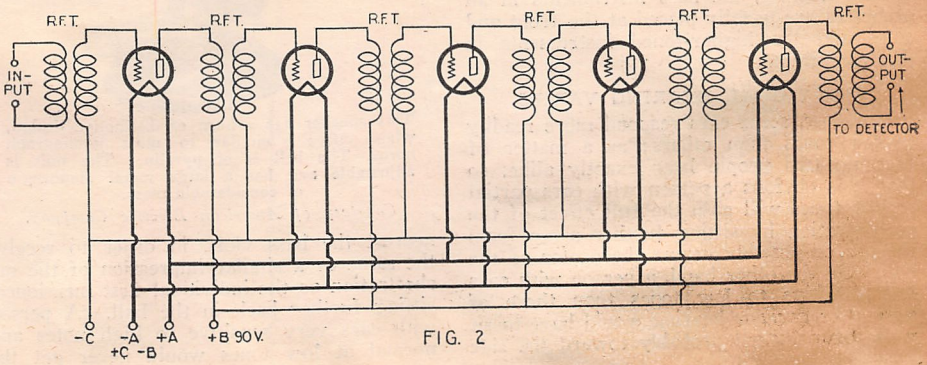


FIG. 2

Loud Speakers and Their Characteristics

A Treatise on Electro-Acoustic Instruments

By M. L. MUHLEMAN

This speaker has a hard-rubber horn, approximately 21 inches high. The diameter of the bell is 15 inches. The unit is very well built and is permanently adjusted.

Courtesy of Liberty Metal Products Company.

This horn speaker is made of laminated bent wood. The bell portion comprises twenty-four ribs, alternating walnut and mahogany, and is 15 inches in diameter.

Courtesy of The Radio Cabinet Company.

There is a crystalline finish on the all-metal horn of the speaker shown below. The diameter of the bell is 14½ inches; the overall height 21½ inches. The diaphragm of the unit is large and made from a special alloy.

Courtesy of Atwater Kent Mfg. Company.

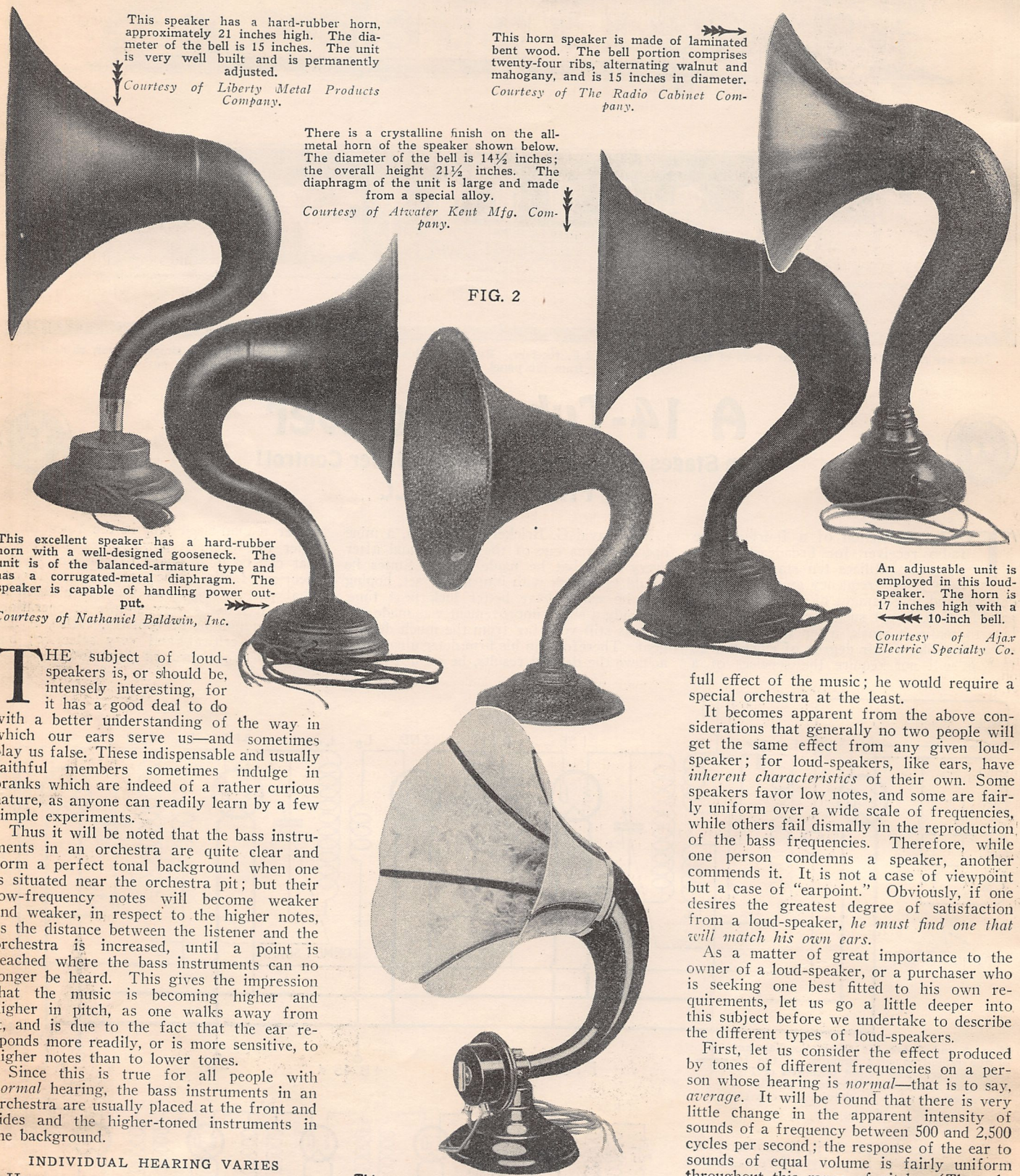


FIG. 2

This excellent speaker has a hard-rubber horn with a well-designed gooseneck. The unit is of the balanced-armature type and has a corrugated-metal diaphragm. The speaker is capable of handling power output.

Courtesy of Nathaniel Baldwin, Inc.

An adjustable unit is employed in this loud-speaker. The horn is 17 inches high with a 10-inch bell.

Courtesy of Ajax Electric Specialty Co.

This speaker has a horn of distinctive design, whose curve is similar to most phonograph horns. The bell is of pyralin. The unit is adjustable and has a large metal diaphragm of considerable mass.

Courtesy of American Electric Company.

THE subject of loud-speakers is, or should be, intensely interesting, for it has a good deal to do with a better understanding of the way in which our ears serve us—and sometimes play us false. These indispensable and usually faithful members sometimes indulge in pranks which are indeed of a rather curious nature, as anyone can readily learn by a few simple experiments.

Thus it will be noted that the bass instruments in an orchestra are quite clear and form a perfect tonal background when one is situated near the orchestra pit; but their low-frequency notes will become weaker and weaker, in respect to the higher notes, as the distance between the listener and the orchestra is increased, until a point is reached where the bass instruments can no longer be heard. This gives the impression that the music is becoming higher and higher in pitch, as one walks away from it, and is due to the fact that the ear responds more readily, or is more sensitive, to higher notes than to lower tones.

Since this is true for all people with *normal* hearing, the bass instruments in an orchestra are usually placed at the front and sides and the higher-toned instruments in the background.

INDIVIDUAL HEARING VARIES

However, some ears respond more readily to low tones than others; as a matter of fact, no two people hear exactly alike, so that it is obvious a person with ears partial to low tones will gain the full effect of the orchestration by sitting further away from the pit, or possibly nearer the center of the hall. On the other hand, a person with ears less sensitive to low tones than those of *normal* or *average* hearing would have to sit well forward, and probably toward the side nearest the bass viols, in order to receive the same or a similar impression of the orchestration as the individual first mentioned, sitting further back in the hall. A person with ears very sensitive to high notes and normal at low tones would never get the full effect of the music; he would require a special orchestra at the least.

It becomes apparent from the above considerations that generally no two people will get the same effect from any given loud-speaker; for loud-speakers, like ears, have *inherent characteristics* of their own. Some speakers favor low notes, and some are fairly uniform over a wide scale of frequencies, while others fail dismally in the reproduction of the bass frequencies. Therefore, while one person condemns a speaker, another commends it. It is not a case of viewpoint but a case of "earpoint." Obviously, if one desires the greatest degree of satisfaction from a loud-speaker, *he must find one that will match his own ears.*

As a matter of great importance to the owner of a loud-speaker, or a purchaser who is seeking one best fitted to his own requirements, let us go a little deeper into this subject before we undertake to describe the different types of loud-speakers.

First, let us consider the effect produced by tones of different frequencies on a person whose hearing is *normal*—that is to say, *average*. It will be found that there is very little change in the apparent intensity of sounds of a frequency between 500 and 2,500 cycles per second; the response of the ear to sounds of equal volume is fairly uniform throughout this range of pitch. (The subject of musical tones and the frequencies—in numbers per second—to which they correspond is very clearly and simply explained in RADIO NEWS for June, 1926—page 1662—and it will be of value to the reader to consult these pages if he is not already familiar with their contents).

Below 500 cycles, however, the sensitivity of the normal ear is appreciably lessened; at 200 cycles it is only fair, and it is comparatively insensitive at 60 cycles and fre-

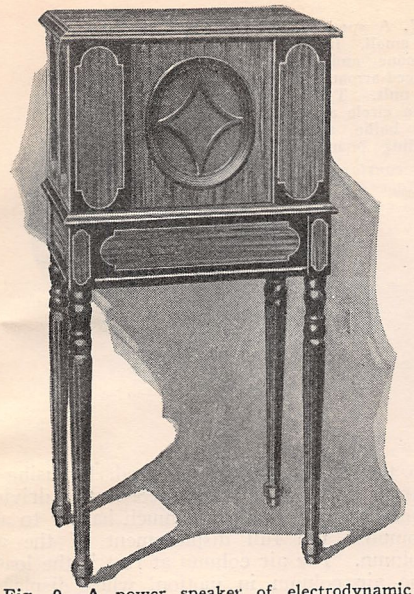


Fig. 9. A power speaker of electrodynamic type with a free-floating cone of small diameter, which moves back and forth like a piston. Aside from the speaker, the cabinet includes a power amplifier and a unit operating it direct from the house current, which will also supply "B" voltage to the set it is used with.

Photo courtesy of Radio Corporation of America.

quencies lower than this, where feeling supersedes hearing oftentimes.

At the other end of the scale, the sensitivity of the ear again lessens when the tone exceeds 4,000 cycles in frequency; but this does not become very serious until another octave is passed and about 8,000 cycles is reached.

EFFECT OF FREQUENCY ON LOUD-SPEAKERS

Most of the musical tones, therefore, which can be appreciated by the average ear, and which are employed in musical composition, fall within the frequency band which extends between 40 and 6,000 or possibly 7,000 cycles. In listening to the composition of these which makes a chord, the human ear loses very little of the high frequencies; but it is considerably handicapped on frequencies below 200 cycles.

In the curve of Fig. 1 is shown the tonal or "distortion" characteristics of a loud-speaker, of the small free-edge-cone type. It is seen that the "amplitude" of the air waves, or pressure of sound produced by the speaker in response to signals between 1,000 and 7,000 cycles, is quite uniform, and similar to the characteristics at high frequencies, of the normal human ear.

Between 400 and 1,000 cycles, however, there is a considerable increase in the amplitude and correspondingly in the volume of sound. This is undesirable, from the standpoint of the average listener; because the ear shows no great lack of sensitivity until the frequency falls below 400 cycles. This is just the point where the amplitude of the sound produced by the loud-speaker takes also a sudden drop. The consequence is that these notes of low frequency are heard too feebly, because both the loud-speaker and the ear are inefficient at this end of the scale. In effect, we are "sitting too far away from the orchestra."

SUITING THE SPEAKER TO THE EAR

Now consider the "response factors" to audible frequencies of persons whose hearing is of unusual nature. The first is that of one who hears better the low frequencies; and consequently would be better suited by a speaker less efficient in this range of tones. On the other hand, a person whose ears respond consistently to all frequencies is also abnormal. A loud-speaker would be better suited to them if it registered the highest and the lowest frequencies less strongly, and the central range of the audible scale with comparatively more volume than the average listener requires.

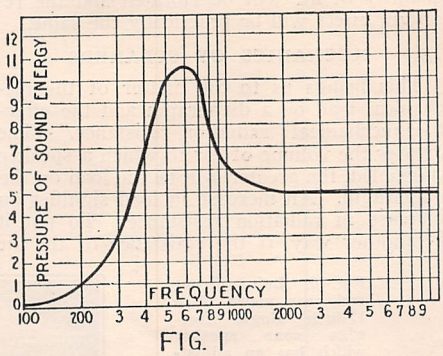


FIG. 1

The "frequency curve" of a small, well designed, free edge cone speaker of the Rice-Kellogg type. Note the increase in sound energy from 400 to 600 cycles and the even response above 1,500 cycles.

It may have been presumed, from what has already been said, that the characteristic curve of the small free-edge cone speaker shown in Fig. 1 is far from being a good one. As a matter of fact it is an excellent curve as loud-speaker curves go. Stop to consider the point that, under most conditions, the music you hear from an orchestra in a music hall appears to be somewhat weak on the low tones for the reasons already outlined; and it becomes evident that the drop of the loud-speaker curve below 400 cycles is not really a serious matter so far as the requirements of the normal ear are concerned. *The average ear cannot distinguish a change in the amplitude of sound less than* 10 *per cent.*

This "distortion curve" as we may call it, is characteristic of our ears if they are normal. Bass instruments in an orchestra, when broadcasting, are given dominance so that the desirable low-frequency background will be present at the receiving end.

All of this leads to another very interesting point. Any orchestra may sound vastly different to me from the manner in which it does to you; and if I could hear it exactly as you do I might not appreciate it at all. So, if we judge music in different manners—that is to say, if our "earpoints" are at variance—we cannot very well agree on the matter of loud-speakers; even though the speaker under judgment is found by electrical test to be perfect in the reproduction of audible frequencies.

The outline of individual differences in hearing, given above, serves to point out the fact that the speaker that satisfies me may not suit you at all.

EFFICIENCY (?) OF SPEAKERS

But, for all of this, we know that some loud-speakers are distinctly poor and others prominently superior; we are inclined to prefer those which favor the bass notes. Yet in respect to electro-acoustic efficiency they are all much the same; *very few ever show an efficiency greater than 2%.* The average speaker, operated under normal conditions, wastes 99% of the energy put into it.

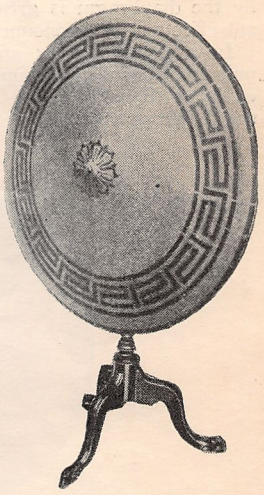


Fig. 5. This cone is three feet in diameter. It is virtually a power speaker but operates as well on an ordinary two-stage A. F. amplifier. The advantage in the exceptionally large diameter of the cone is evidenced by the perfect reproduction of bass notes.

Photo courtesy of Western Electric Company.

Approximately 23% is acoustic loss, the dissipation taking place in the horn or diaphragm, as the case may be, and in the base

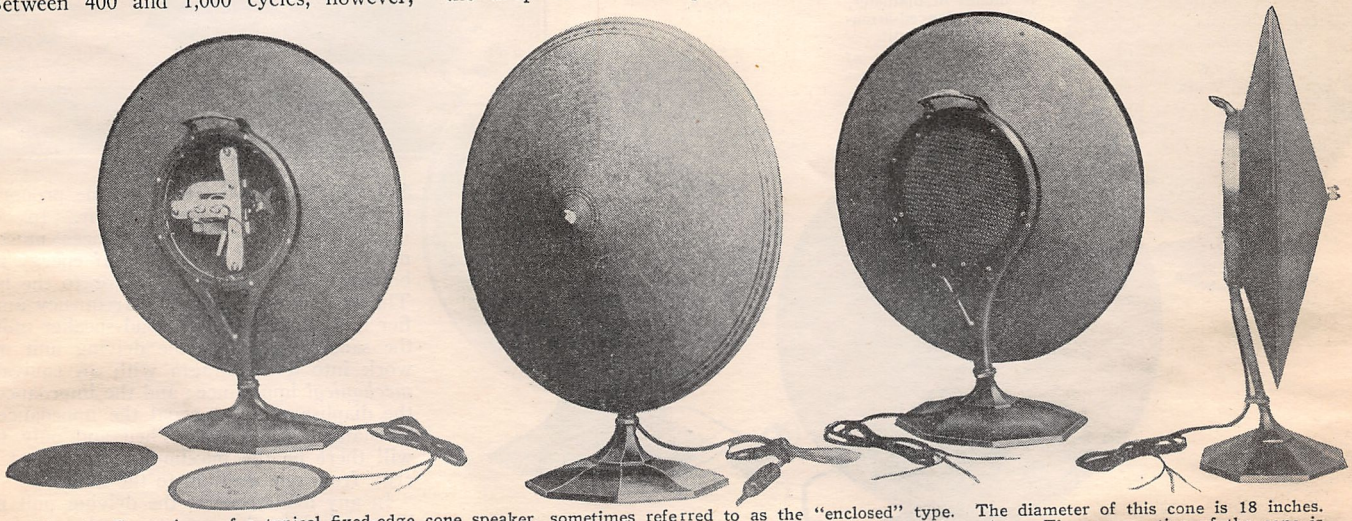


Fig. 4. Four views of a typical fixed-edge cone speaker, sometimes referred to as the "enclosed" type. The diameter of this cone is 18 inches. The drive unit is of the balanced-armature type and has a very large permanent magnet, seen in the first view. The rear portion of the cone is actually a flexible support; it contributes to the "reflection characteristics" of the speaker and is an effective baffle.

Photo courtesy of Western Electric Company.

and the baffle, if there is one. The other 76% loss is through excess damping in the mechanical parts (including the resistance load or "radiation resistance") and electrical "eddy currents," "hysteresis" (magnetism) loss and resistance loss. The other 1%, fortunately, does useful work and is converted into sound. This suggests that the loud-speaker is an insult to efficiency. The best we can do is forget the 99% waste until some engineer is visited by an unearthly inspiration and becomes able, through practical experience, to demonstrate the contention that "there is a tape worm in the works of present-design loud-speaking telephones."

HORN AND CONE PRINCIPLES

Coming to the tonal or "distortion" characteristics of loud-speakers, which after all is the point of most importance, we find a striking similarity between the horn types and the diaphragm (cone) types. The mechanical and electrical properties of both are also very much alike, and both types are limited to practically the same conditions. In the horn speaker we have an electrical "driving unit" magnetically coupled with a small diaphragm to vibrate air through the air column contained in a horn. The actual diameter of the diaphragm may be no more than two or three inches; but its effective diameter is considerably greater, and is dependent on the shape and size of the horn. If the horn is small the column of air that can be "worked" is likewise small. On the other hand a large horn incloses a greater volume, and so the amount of air vibrated by the diaphragm is greater and the resultant effects more pronounced.

In a cone speaker an electrical driving unit is mechanically coupled to a diaphragm of large diameter. The actual diameter of the diaphragm of a cone speaker is also its effective diameter, as no horn is employed. Increasing or decreasing the diameter of the diaphragm will increase or decrease the mass of air which can be "worked." It is obvious then that the difference between the horn and cone speakers is only a mechanical one. In one case the speaker is coupled to the air through a horn, in the other through an oversize diaphragm; yet with a cone and horn speakers of equal effectiveness the same quantity of air will be vibrated and the resultant effect will be practically the same.

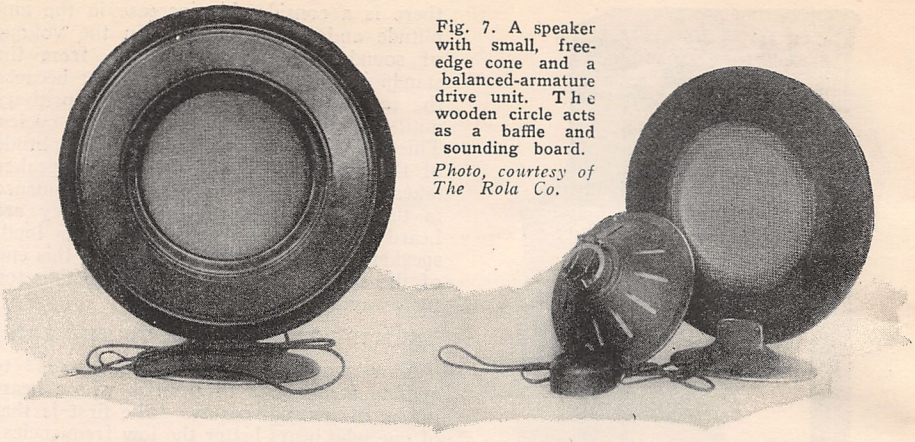


Fig. 7. A speaker with small, free-edge cone and a balanced-armature drive unit. The wooden circle acts as a baffle and sounding board.
Photo, courtesy of The Rola Co.

MECHANICS OF SPEAKERS

This brings us to the matter of the mechanical load on a diaphragm and the effective mechanical "radiation resistance." The greater the volume of air to which a speaker is coupled, the greater will be the load on the diaphragm. An increase in load signifies an increase in radiation resistance. To put it in another way, if the resistance of the air to the diaphragm is increased, by using a larger horn or a larger cone, the driving unit has to push just so much harder to accomplish the full displacement of the air column. The air column at rest is the load; the air column in motion, when displaced by the movement of the diaphragm, is the *radiation resistance.*

This makes it apparent that a great deal of importance is attached to the correct design of the driving unit and the diaphragm. If the weight or mass of the diaphragm is too great for a given mass of air, the functioning of the driving unit is impaired. We would say in such a case that there was too much *"damping"* or "limiting of motion."

In calculating the effective size of a diaphragm, the mass of air to be worked must also be taken into consideration. It can be considered as exerting a force or pressure against the diaphragm at all times. Actually, the driving unit must match the diaphragm and the diaphragm must in some proportion match the effective mass of air. In other words, the respective impedances must be made equal if the maximum of energy is to be transmitted from one factor to the next. The last tube in the audio-frequency amplifier must "work" into a loud-speaker unit of the same impedance; the driving unit must work into a diaphragm with an equivalent *mechanical* impedance; and the impedance of the diaphragm must equal the impedance or resistance of the air. Then and only then will there be the maximum transfer of energy from one medium to the next.

In any loud-speaker, the driving unit may be matched to the output impedance of any type of vacuum tube by employing the correct number of turns of wire in the electro-

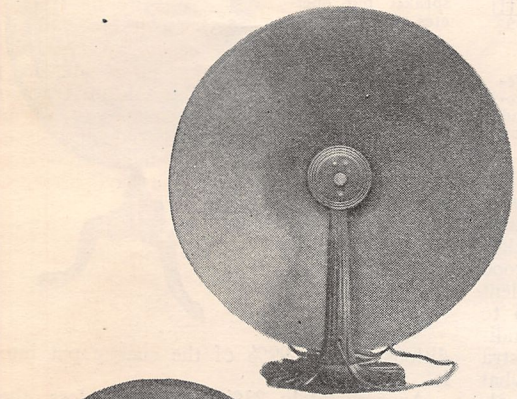
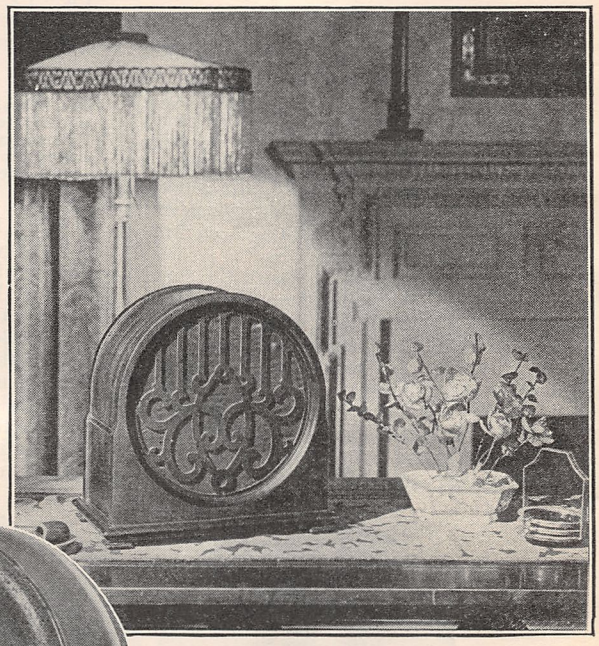
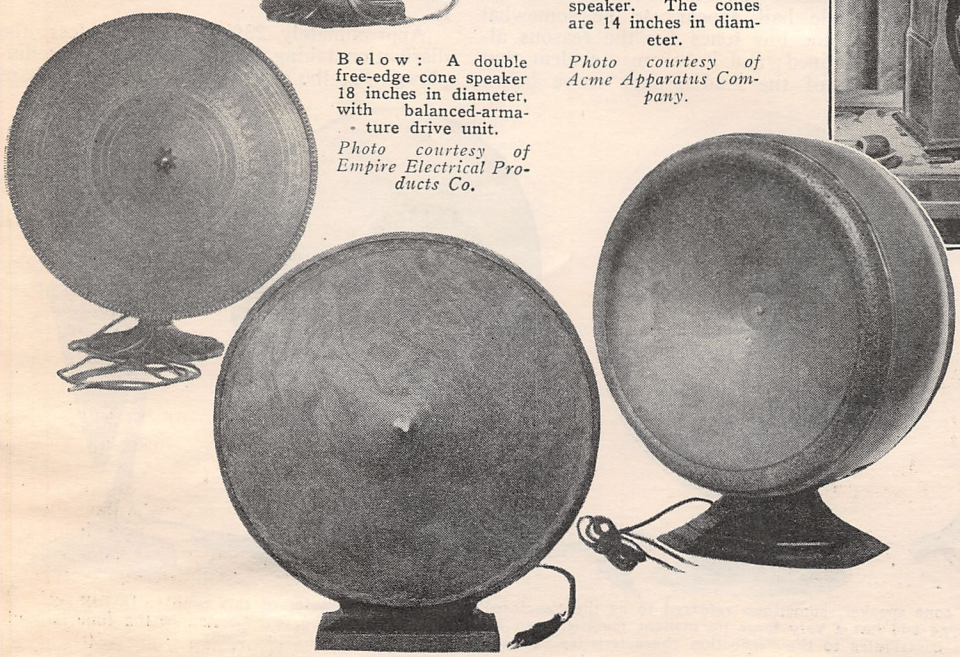


Fig. 6. Left: Front and rear views of a 17-inch single free-edge cone speaker which has an adjustable direct-drive unit, and eight points of contact with the cone.
Photos courtesy of Tower Mfg. Company.

Right: A single free-edge cone speaker in a cabinet. The enclosure acts as a baffle.
Photo courtesy of The Amplion Corp. of America.

Below: Another double free-edge cone speaker. The cones are 14 inches in diameter.
Photo courtesy of Acme Apparatus Company.





Below: A double free-edge cone speaker 18 inches in diameter, with balanced-armature drive unit.
Photo courtesy of Empire Electrical Products Co.

magnet. The driving unit may be matched to the diaphragm by increasing or decreasing the damping of the mechanism; that is, either by increasing or decreasing the weight of the moving parts, limiting their action by means of some sort of spring or leverage attachment. The diaphragm is proportioned to the resistance of the air by altering its area and increasing or decreasing the size or shape of the horn, or (in the case of a cone speaker) the diameter, mass and inherent damping effects of the diaphragm itself.

It stands to reason that, the larger the horn or cone speaker, the more energy will be required to operate it satisfactorily, because the quantity of air to be worked is considerably greater. Virtually the effective impedance of all the transmission mediums in the speaker, including the impedance exerted by the air, is altered by a change in frequency. It is of prime importance to employ a power amplifier with a large loud-speaker, and even with a small one, if it is desired to gain the full effect of the low-register notes.

HORN SPEAKERS

A more extended description of the design and characteristics of the horn type of

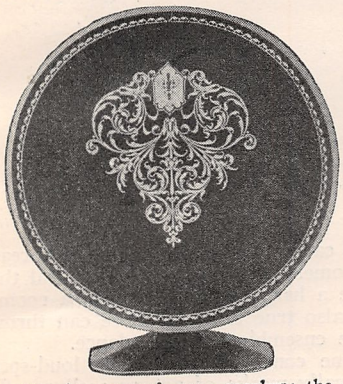


Fig. 10. An eccentric-cone speaker; the drive rod is attached off center to the cone. The short and long surfaces thus created provide suitable vibrating areas for both high and low notes.

Photo courtesy of H. G. Saal Company.

speakers may serve to convey a better understanding of the idiosyncrasies generally attributed to them. A group of them are shown in Fig. 2. The differences lie mostly in the size and shape of the horns which, in all the illustrated types, are made of some form of non-resonant material such as a fiber composition, wood fabrications, thick metal with a "dead" coating, hard rubber, etc. The utilization of a non-resonant material in the horn partially eliminates "resonance points," which would tend to alter the true characteristics of the heterogeneous frequencies being reproduced. You may recall the older type of loud-speaker with a thin metal horn. They had a tinny sound, all their own, most frequently superimposed on the music or speech and giving it a peculiar if not appalling sound.

As we have pointed out before, the diaphragm is *coupled to the air* by the horn. The shape and length of the horn particularly affect the tone of the speaker. The usual run of horn speakers are weak on the low tones and rather a bit too emphatic in their handling of the intermediate and sometimes of the high frequencies. The bass notes become more prominent as the length of the horn is increased; with an attendant change in the damping of the diaphragm. Theoretically, all of the audible frequencies can be reproduced faithfully, only when the horn has assumed a length of 20 feet. Practically, of course, a horn as long as this is out of the question.

However, for all ordinary purposes a horn from 4 to 6 feet in length is perfectly satisfactory, and it will provide true reproduction of most of the bass notes. If care is taken in the design of the horn, a 4- or 6-foot length can be included in a very small compass, as evidenced by the two speakers shown in Fig. 3. The increased length of the resonating air column comes closer to the wavelengths of the bass notes, which are much longer than those of the high notes; and consequently the air column of the horn can be set in motion by the low notes. This is quite impossible in a short horn as its air column is too short.

A low-register response in a horn speaker can be accomplished artificially by employing a diaphragm or a horn designed to resonate at some low frequency. A large diaphragm with considerable mass will do it, as well as a horn made of certain types of wood. However, most attempts to accomplish this have resulted in producing speakers not very natural in sound. I know of but two manufacturers who have been successful in this respect.

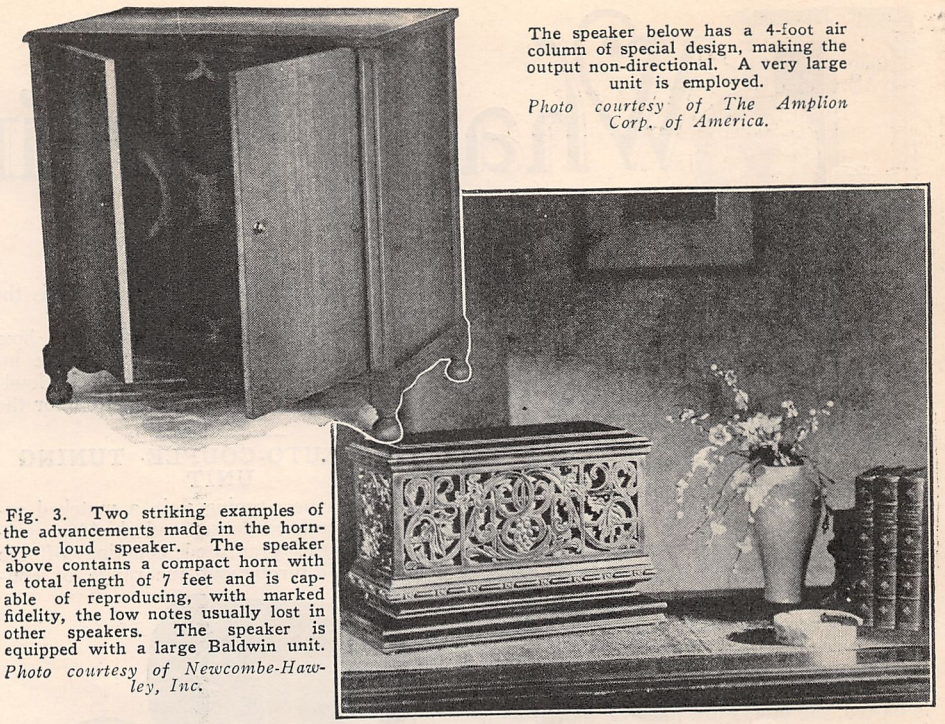
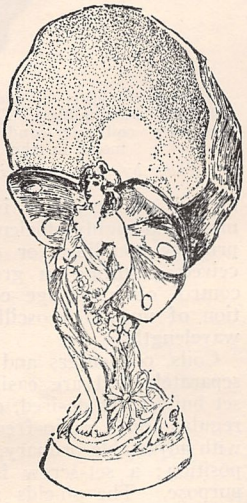


Fig. 3. Two striking examples of the advancements made in the horn-type loud speaker. The speaker above contains a compact horn with a total length of 7 feet and is capable of reproducing, with marked fidelity, the low notes usually lost in other speakers. The speaker is equipped with a large Baldwin unit.

Photo courtesy of Newcombe-Hawley, Inc.

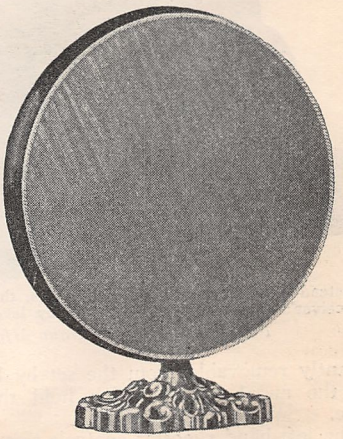
The speaker below has a 4-foot air column of special design, making the output non-directional. A very large unit is employed.

Photo courtesy of The Amplion Corp. of America.



The artistic speaker here illustrated is one solid piece of molded non-resonant material and, therefore, has no definite resonance points of its own. The height of the speaker is 24 inches and the diameter of the bell 12 inches.

Photo courtesy of Florentine Art Products, Inc.



A typical form of disc speaker with characteristics somewhat similar to a fixed-edge cone speaker.

Photo courtesy of English-Whitman Products.

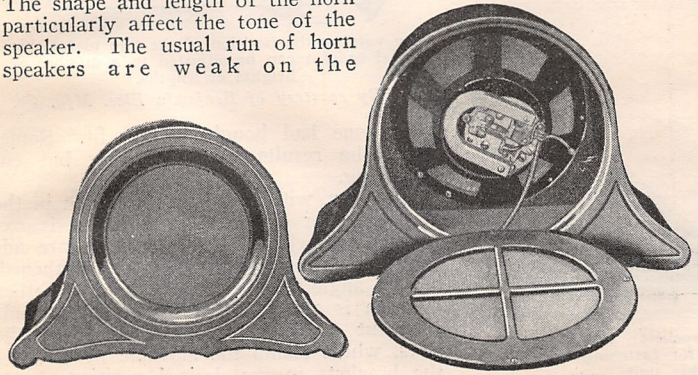


Fig. 8. A fine example of a speaker with a small free-edge cone. The drive unit is of the balanced-armature type employing an oversize permanent magnet. The cone is virtually floating, the only actual support being the stout drive rod. The casing in which the cone is mounted acts as a baffle and sounding board.

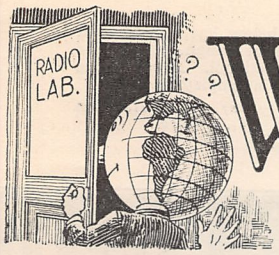
Photo courtesy of The Magnavox Company.

DIAPHRAGM SPEAKERS

Diaphragm speakers, which include those of the cone or disc type, present some very interesting points, though in fundamental principle they are not so unlike the horn type of speakers as most people imagine.

Four views of a typical cone speaker of the "inclosed" or "fixed-edge" type are shown in the illustration of Fig. 4. The speaker is seen to consist of a base, an elec-

(*Continued on page* 750)



What's New in Radio

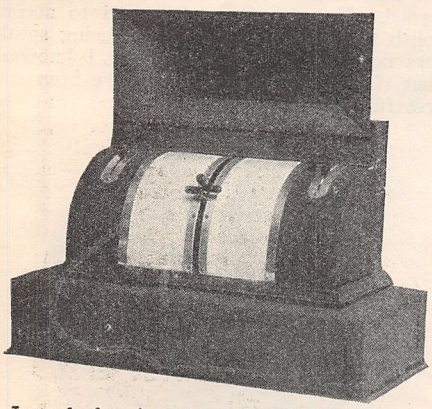
READERS may obtain the addresses of any or all of the manufacturers whose products are described here by writing to the "What's New in Radio" Department, RADIO NEWS, 53 Park Place, New York City. A stamped and self-addressed envelope should accompany each request.

NEW RECEIVER WITH NOVEL CONTROL

The tuning is accomplished by means of levers connected to the condenser shafts, these levers extending through the casing of the set and being held in frictional engagement with each other. When the main lever is moved, the others are likewise moved with it, but either of the other levers may be moved independently for balancing the different circuits over the entire wave band.

A pointer on the main tuning lever registers with the log sheets on either side. One of these log sheets is printed with a list of high-power stations, and as individual receivers may vary slightly in tuning, it is only necessary to carry a pencil line from the station name to the point where it comes in on the scale. The other sheet is left blank for logging stations that are received from time to time.

After the log is completed, transparent sheets are placed over the log to prevent their becoming soiled. These log sheets are



Instead of tuning with the usual dials, this receiver's condensers are adjusted by levers.
Photo by courtesy of Dunn Mfg. Co.

instantly removable from the set by loosening the metal bands, which hold them in place.

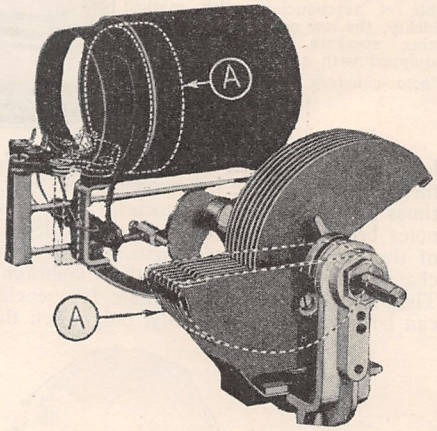
The left-hand rheostat controls two radio-frequency tubes and the volume of the set. The right-hand rheostat controls the detector and two audio tubes and it has been found that tonal qualities are best taken care of by this arrangement. The other button shown is the filament switch. At the rear of the set, the five tubes are in a straight line, the metal cap covering the upper end of the tubes. The binding post strip is at the rear of the tubes and is entirely open and accessible for easy hook-up.

The chassis assembly within the cabinet is in one unit and, by removing the tube cover and taking out four screws, the entire assembly may be removed from the cabinet for inspection or adjustment. The cabinet, itself, is of metal and effectively shields the wiring assembly.

The unit assembly including battery box, receiver and speaker is but twenty-one inches high, which brings the bell of the loud-speaker in a very convenient position for the listeners.

THE AUTO-COUPLE TUNING UNIT

Here is a new tuning unit, a matched assembly of coil, condenser and shield providing automatic, graduated coupling of the primary coil throughout the range of con-



This combination of inductance and capacity is for R.F. amplifiers. The positions, A, of the primary coil and condenser show how they move in the same time.
Photo by courtesy of Hammarlund Mfg. Co.

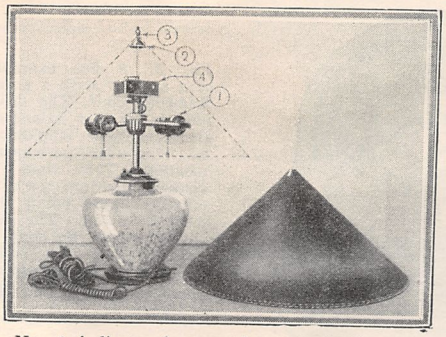
denser settings. It is strong, accurately made and highly efficient. It insures correct primary coupling for each wavelength received, resulting in greater selectivity and control of interstage coupling and prevention of unwanted oscillations on the lower wavelengths.

Coils, condensers and shields may be had separately and are easily assembled by the set builder. If desired, coils may be used as regular tuned radio-frequency transformers, with adjustable primary, fixed at any desired position; a set-screw is provided for that purpose. The shields are designed to enclose the complete assembly, together with a tube and its socket.

This assembly is used in a new special receiver, as described in this issue of RADIO NEWS. (See page 652).

LAMP-CONE LOUD-SPEAKER

Lately there has been much said in various publications about matching the finish of



No. 1 indicates lamp sockets; 2, inside cone support; 3, screw-nut for fastening cone; 4, loud-speaker unit.

The assembled lamp-loud-speaker. On the left side, above the base, is a switch to turn off the speaker.
Photos by courtesy of Aristocrat Studios.

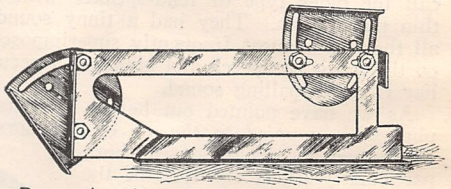
radio cabinets with the furniture already in the home. Nothing is more natural than to desire a harmonious scheme in a room, and it is also true that one piece can throw the whole ensemble out of balance.

Some cone- and horn-type loud-speakers are really works of art, as well as efficient reproducers; but, sad to say, this is not always the case. However, in the combination loud-speaker and table lamp shown in the accompanying illustrations, there will be found a worthy piece of furniture as well as a radio accessory that will please almost anyone.

The shade of the lamp, in which orange tints relieve the monotony of the usual parchment or paper shade, functions as the speaker diaphragm, being actuated by the unit just above the lamp brackets. The base of the lamp is a very attractively colored vase, heavy enough to insure stability.

ADJUSTABLE BRACKETS

Heretofore, when sub-panels were being attached to front panels, it was more or less of a gamble that everything would come just right, or that the brackets,



By varying the position of the two plates this panel bracket can be adjusted to a number of heights or lengths.
By courtesy of Benjamin Elec. Mfg. Co.

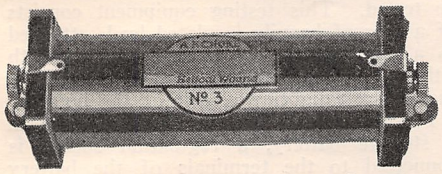
which one had bought, would fit. Sometimes the results were anything but encouraging.

However, with the brackets shown in the accompanying sketch, this situation is extremely unlikely, as these brackets are adjustable. Not only can they be lengthened, but the angle may be varied as well. Either or both is accomplished by the simple adjustment of four nuts and bolts in the slots, which clamp the movable portions of the brackets in the desired position.

AUDIO-FREQUENCY CHOKES

Most of the instability, and a part of the distortion often evidenced in transformer-, impedance- or resistance-coupled audio-frequency amplifiers, is brought about by undesirable coupling, of the respective plate circuits of the vacuum tubes, through the common "B" battery or "B" eliminator.

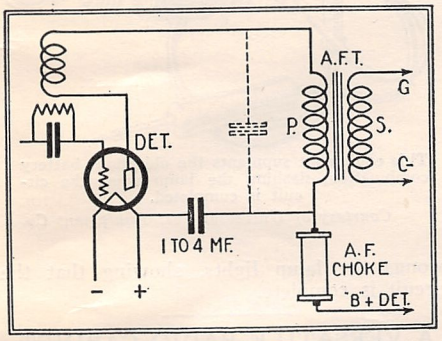
These difficulties may be eliminated by the use of audio-frequency choke coils in con-



A.F. chokes of this type may be used to great advantage in bettering reproduction of signals.
Photo courtesy of Samson Elec. Co.

junction with by-pass condensers of from 1-mf. to 4-mf. capacity, inserted in series with the plate circuit of each audio-frequency tube, and the detector tube as well. The insertion of the choke does not impede the normal flow of plate current, but it effectively obstructs the audio-frequency currents and prevents them from passing through the "B" battery. These currents are instead by-passed to the filament circuit through the fixed condensers.

The audio-frequency choke shown in the accompanying illustration has a self-capacitance of only 5 mmf. This low value is made possible by the special helical-coil construction. The inductance of the choke, at



How the A.F. choke may be connected in the detector circuit.

60 cycles, is 3.5 henrys, and the direct-current resistance is 640 ohms. The current-carrying capacity of the choke is 60 milliamperes, more than it will ever have to handle under normal conditions, even in the circuit of a power amplifier.

The direct-current resistance of the choke is not high enough to cause an appreciable drop in voltage when in the "B" battery circuit.

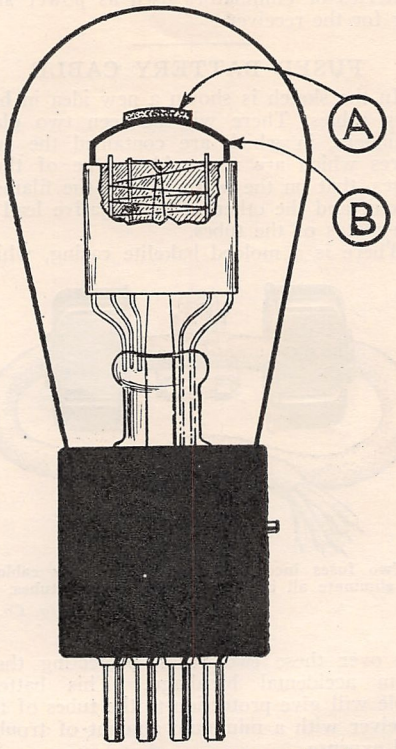
Due to the low self-capacitance of the unit it is an effective radio-frequency choke.

These chokes can be used to advantage in any circuit where a high impedance is required. The unit is 4¼ inches long, 1½ inches in diameter.

A HIGH "HIGH-MU" TUBE

To obtain a satisfactory degree of amplification from a resistance- or impedance-coupled audio-frequency amplifier, and at the same time attain the greatest amount of efficiency, it is of prime importance to utilize vacuum tubes with a high amplification factor. The reason is quite obvious when it is taken into consideration that the total amount of amplification obtainable in a single resistance-coupled stage can never exceed the "amplification factor" (known in formulas as "mu") of the tube employed; the coupling resistances are in no way contributory to the voltage step-up. A stage of impedance-coupled amplification contributes slightly to the voltage step-up, but not so much that matters cannot be greatly improved by employing a "high-mu" tube.

The manufacture of "high-mu" tubes is an art in itself, and in it there are encountered many difficulties which have hitherto prevented the commercial mass production of a tube with an amplification factor greater than 28 or 30. One manufacturer, however, has lately managed to produce uniform tubes having an amplification factor of 40. The success is due in most part to a new exhausting process differing from the usual method,

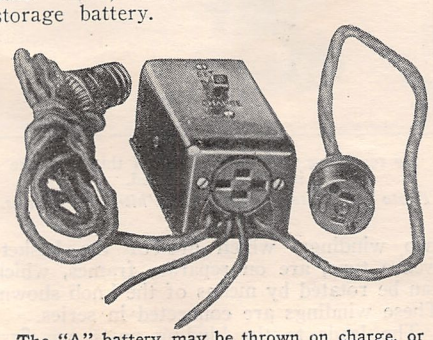


The "getter" material, A, does not function until after the usual "degasifying" process. B is a special metal arch used to ignite the "getter."
Courtesy of Ken-Rad Corp.

in the respect that the "getter" material, which absorbs gas remaining in the tube, does not carry out its function until after the tube has been "degasified" by heating the elements to a high temperature, and sealed. Means are provided for preventing the "getter" from vaporizing during the usual degasifying process. It can be vaporized at any time subsequent to the exhausting operation by placing the tube in the magnetic field of a high-frequency generator.

A MASTER-CONTROL SWITCH

Herewith is pictured a control switch that takes a great deal of the guess out of the battery situation. It will be seen that on this simple little instrument there are two sets of leads, terminating in lamp plugs; one of them goes to the lighting circuit and the other to the battery charger, usually one of the trickle type. There are also two other leads, which are connected to the storage battery.



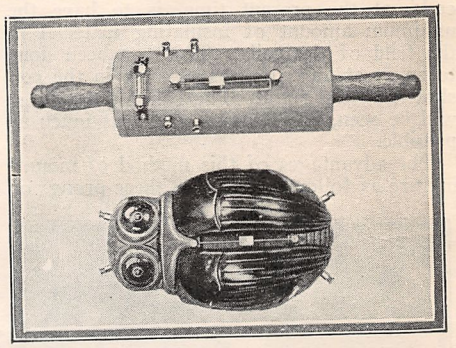
The "A" battery may be thrown on charge, or connected to the set, by throwing the switch.
Photo by courtesy of Elec. Storage Battery Co.

This is indeed an aid for the lazy-minded person, who wishes to forget all about the cares of a radio set. No longer is it necessary to disconnect the battery leads from the storage battery and substitute those of the charger, after listening to a concert; this is done by simply "throwing" the switch to "charge." This puts the battery on charge until you wish to listen-in again; the switch being then merely thrown to the other side.

A device of this nature is especially convenient for the person who wishes to have his set in one part of the house and the power equipment in another. It saves trips between the battery and set for charging purposes.

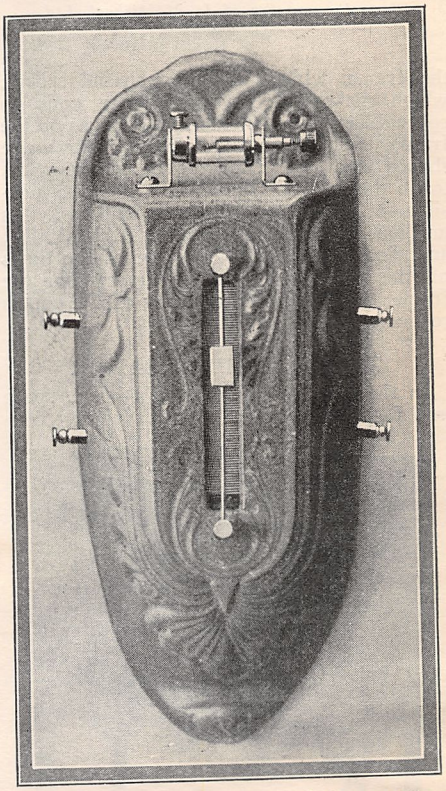
THREE UNIQUE CRYSTAL RECEIVERS

The three illustrations show novel ideas in simple receivers. These are primarily for the person who does not wish to be



Two unique crystal receivers, the upper one being constructed inside a wooden rolling-pin and the other in a "bug" of burned stone.

bothered with batteries and the care that must be exercised upon them. It is also a well known fact that reception with a crystal receiver gives as clear reproduction of



A wall-type crystal receiver, of the same insulating material as the "bug" shown above.
Photos by courtesy of Brush Pottery Co.

signals as can be obtained; so that, all in all, these sets are good from the viewpoint of novelty of make-up as well as reception.

The body of the "bug" and the wall re-

ceiver are made of hard, burned stone, which has excellent insulating properties. In the case of the bug the crystal detector is of the fixed type and is mounted in the head, the mountings being the pupils of the eyes. The head-phones are connected in the place where the antennae of the bug would be, and in place of hind legs the antenna and ground connections are made.

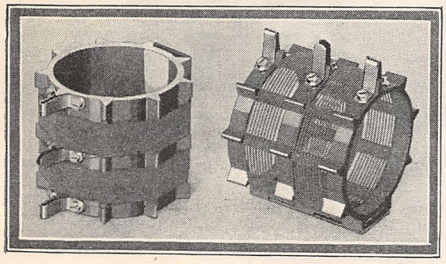
The rolling-pin receiver has the set mounted within the cylinder with only the slide tuner, the detector, and the binding posts showing. This receiver is made of wood, following the model so skillfully used by housewives.

The third set is to be hung on the wall and, as may be seen, it is extremely simple to install. It is claimed that the insulating properties of this material are so high that exceptional reception results.

NEW INDUCTANCE COILS

The tendency of designers of inductance coils, at the present time, is to have the minimum amount of insulating material in the field of the coils. This has been done to as great an extent as possible in the coil shown on the right. The bakelite frame, it will be seen, has been cut down as much as possible.

The advantages of this method of mounting are as follows: there are three prongs on



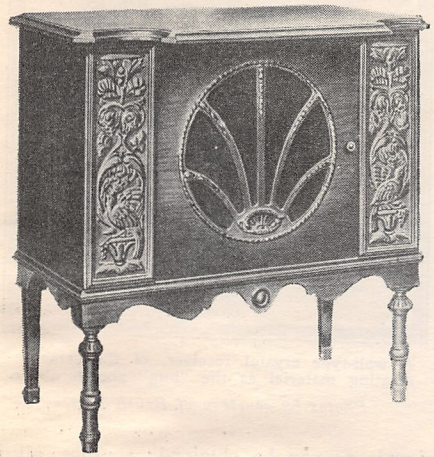
Inductances wound on forms such as here shown are said to have a minimum of losses.
Photo by courtesy of L. McMichael, Ltd. (England)

the frame, which fit into a special socket, which makes it easy to change coils to cover different wave-bands; the ridges on the frame, over which the wire is wound, are shaped to almost a knife-edge, so the wires touch the insulation in as few places as possible—although the frame is cut away as much as possible, it is strong mechanically; and, finally, due to the spacing of the turns of the coil by means of grooves in the frame, the distributed capacity of the coil is reduced.

TABLE CONE SPEAKER

In the average city dweller's home, space is a factor that must be very seriously considered. Surely every person who inhabits an apartment will agree to that. Hence there is a trend, just starting, to condense everything as much as possible.

This consideration, if we may call it such, is typically illustrated herewith. In the front of the door of this radio table will be seen a circular opening. Behind this is a cone loud-speaker attached to the door, which can be swung open without interfering with the speaker connections. Within the cabinet is ample space for the various batteries or eliminators used as power supply for the receiver.

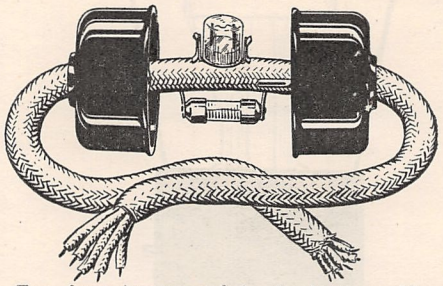


Placing the loud speaker in the door of the battery compartment of this table saves much space.
Photo by courtesy of Reichmann Co.

FUSED BATTERY CABLE

In the sketch is shown a new idea in battery cables. There will be seen two glass cylinders, in which are contained the fuse wires which are renewable. One of these fuses, that on the bottom, is in the filament circuit and the other in the negative lead to the plates of the tubes.

There is a molded bakelite casing, which

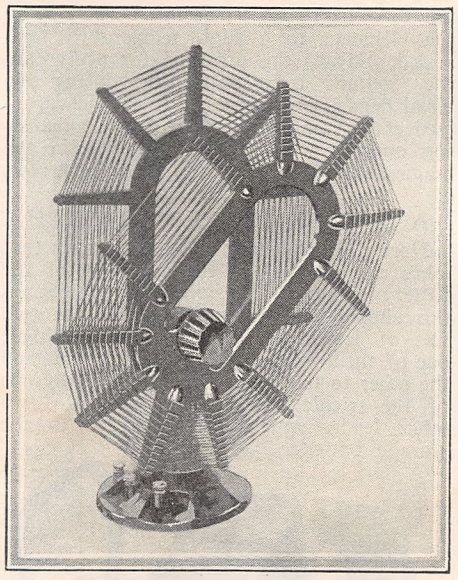


Two fuses incorporated in the battery cable eliminate all chances of blowing out tubes.
Courtesy of Belden Mfg. Co.

fits over these two fuses, protecting them from accidental breakage. This battery cable will give protection to the tubes of the receiver with a minimum amount of trouble and expense.

VARIABLE-LOOP ANTENNA

In order to vary the inductance in the antenna circuit, as well as obtain the directional properties of a loop antenna, the one shown in the illustration was designed. The



By revolving the movable half of this loop, the inductance is varied.
Photo by courtesy of English-Whitman Products.

two windings, which are of the basket-weave type, are on separate frames, which can be rotated by means of the knob shown. These windings are connected in series.

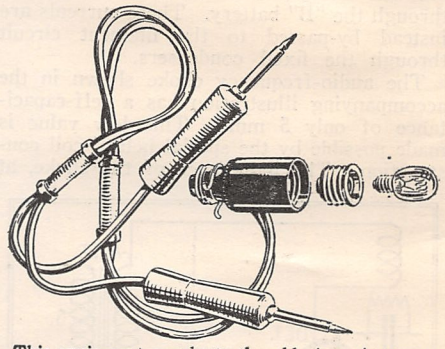
The leads to the binding posts are first brought into the central post of the loop and thence carried to rings in the lower part of it; so that there is always good contact, even though the loop may be rotated again and again.

TESTING LAMP

Here is something which will come in handy as a part of the equipment of every set constructor; for one of the fundamental rules of constructing radio sets is that, when the wiring has been completed, it must be tested. This testing equipment consists of a pair of heavily insulated leads attached to a lamp socket, which can be used with either a storage battery or connected in the 110-volt lighting circuit of the house.

If the outfit is used in conjunction with a storage battery, a regulation socket is connected to the terminals of the battery and the socket shown in the illustration screwed into it. It will be noticed that there is an auxiliary socket for the accommodation of a 6-volt lamp, which is screwed into the socket instead of a 110-volt lamp, which would not light on such small voltage.

The prongs of the test handles are insulated for the greater portion of their length, in order to avoid accidental contacts. When the circuit is completed through the

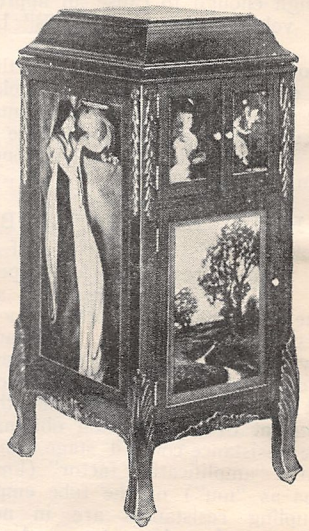


This equipment supplants the old phone battery combination, flashing the lamp when the circuit is completed.
Courtesy of Universal Test Equipment Co.

prongs the lamp lights, showing that the circuit is complete.

A VERSATILE RADIO CABINET

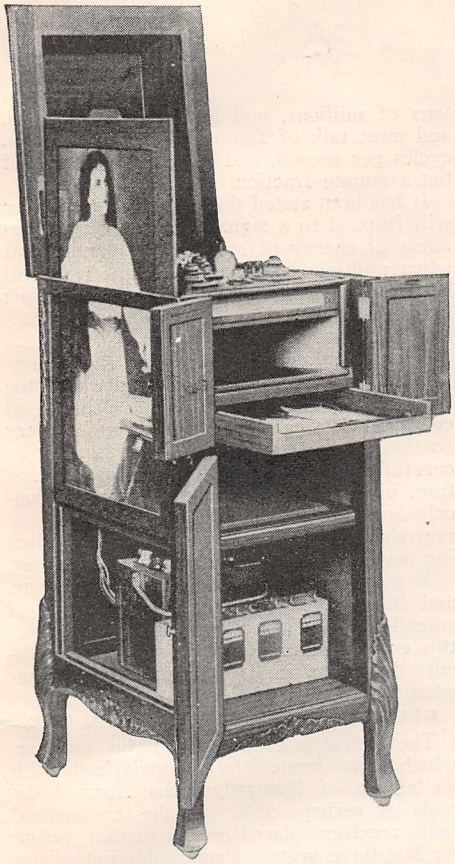
There has been heard some few criticisms that radio furniture is too plain for some tastes, but a glance at the accompanying illustrations will certainly convince the most sophisticated critic that here is a cabinet that can never be condemned as too plain. Not only is it possible to decorate the cabinet to suit one's own taste, but if the owner



How the cabinet appears with all the sliding panels in position.
Photos by courtesy of The New Idea Radio Co.

tires of the pictures or colored panels they may be easily changed.

As may be seen, in the top part of the cabinet there is space provided for a radio receiver, and beneath this the batteries may be kept. A special receiver is obtainable which is designed for this cabinet, embodying a loud-speaker; the assembly may read-



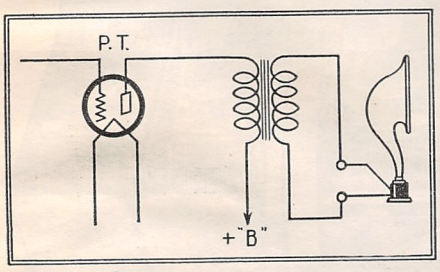
This view shows the position of the radio set, the loud-speaker horn, and the batteries. It also shows how the side panels are exchangeable.

ily be removed from the cabinet and taken on trips as a portable set.

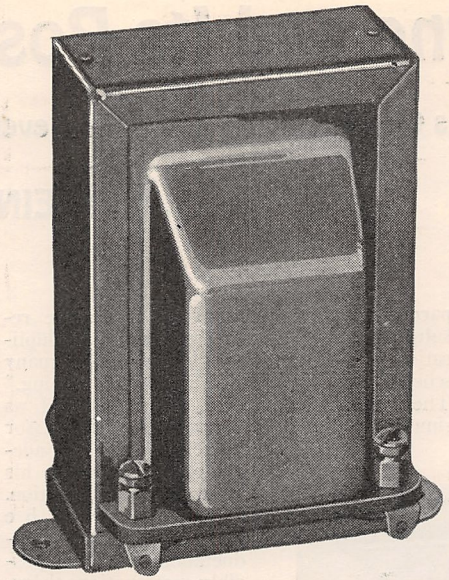
In the sides of the cabinet, and in its doors, are grooves in which the panels on which are placed the pictures are slid to their proper positions. The changing of these decorations can be seen to be a very simple matter. The removable panels also have another advantage in that, when anything has to be done in the battery compartment, they can be slid up out of the way, making access easy. There is also a shallow drawer beneath the receiver compartment in which may be stored log sheets, pencils, etc.

OUTPUT TRANSFORMER

The importance of employing an output transformer or choke between the last stage of audio-frequency amplification and the loud-speaker is not realized by the average fan. Irrespective of whether or not a power amplifier is used, it is desirable to keep the



The primary of this output transformer is placed in the plate circuit of the A.F. power tube, and the loud-speaker is connected to the secondary.



When a power tube is employed in the last stage of the A.F. amplifier it is imperative that a transformer of these characteristics be used.

Photo by courtesy of Pacent Elec Co., Inc.

"B" battery current out of the loud-speaker's windings. A direct current passing through the loud-speaker either repels or attracts the diaphragm, depending upon the direction of the current flow, and thus prevents it from functioning in the normal manner.

It is very important to employ an output transformer or choke, if a power amplifier tube, such as the 171 or 210 type, is employed in the last audio-frequency stage; as the amount of plate current flowing is in many cases sufficient to burn out the loud-speaker's windings, or reverse its polarity.

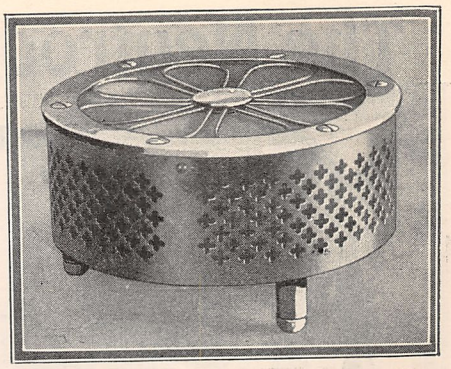
The output transformer shown in the accompanying illustration has a 1:1 ratio and a high primary impedance. The primary winding is connected in the plate circuit of the last tube; consequently one of these transformers can be connected to the output of any radio receiver without the changing of any wiring. The loud-speaker is connected to the two secondary terminal posts.

ANNOUNCEMENT

In the rules for the Hook-Up Contest, published in the August, 1926, issue of RADIO NEWS, it was announced that the awards of prizes would be published in the present number. This has been found impossible, as there are still several receivers entered in the contest, which have not reached RADIO NEWS LABORATORIES, but which the judges wish to consider for a prize. The winners of prizes in this contest will be announced in the January, 1927, issue of RADIO NEWS.—EDITOR.

A METAL CONE SPEAKER

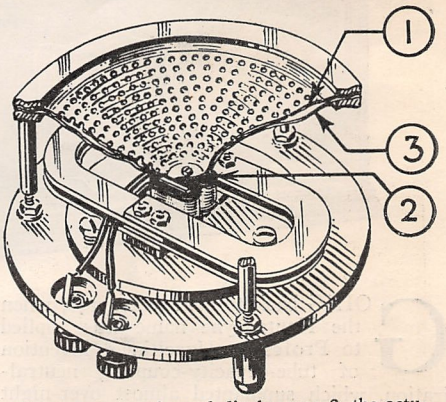
The actuating mechanism of this German loud-speaker, invented by Dr. Seibt, is extremely interesting. Briefly, there is an aluminum diaphragm, approximately one hundredth of an inch thick, tightly stretched in the shape of a cone. At the apex of this diaphragm is placed a small button of iron which is attracted and repelled by the electromagnets, which may be seen under the point of the cone. Over this very thin diaphragm is placed a perforated aluminum sheet quite a bit thicker than the first. This, and cotton batting which is carefully stuffed on the under side of the cone, acts as a damper on the thin cone. The results obtained with this loud-speaker are remarkable, when the small size is considered, as it is only about six inches in diameter.



The assembled loud-speaker for a table. The case is highly-polished metal.

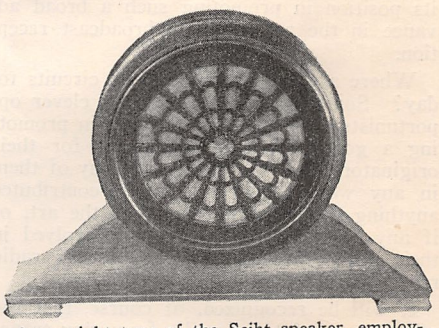
Photos by courtesy of Dr. Georg Seibt.

These loud-speakers are made in several different styles, two of which are shown

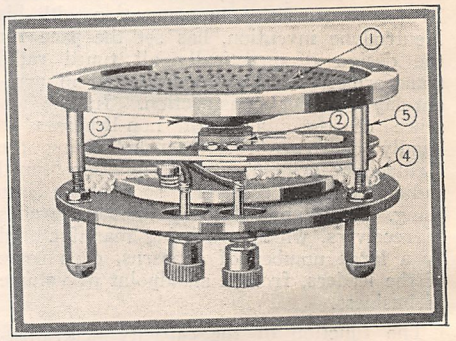


No. 1 is the perforated diaphragm; 2, the actuating mechanism and 3, the thin cone.

in accompanying illustrations. The one in Fig. 1 has a highly polished nickel case, while that in Fig. 2 will be seen to be encased in wood.



An upright type of the Seibt speaker, employ- the same mechanism as the horizontal type.



Cotton, 4, is placed in the space under the cone and inside posts, 5, for baffling.

As usual with all types of cone speakers, there is an adjusting screw on the under side of the instrument. This is to vary the air gap between the magnets and the iron stud. Connections are made to the two binding posts shown on the under side.

The Neutrodyne and Its Position In Radio

How This Circuit Has Affected the Development of the Industry

By R. M. KLEIN*

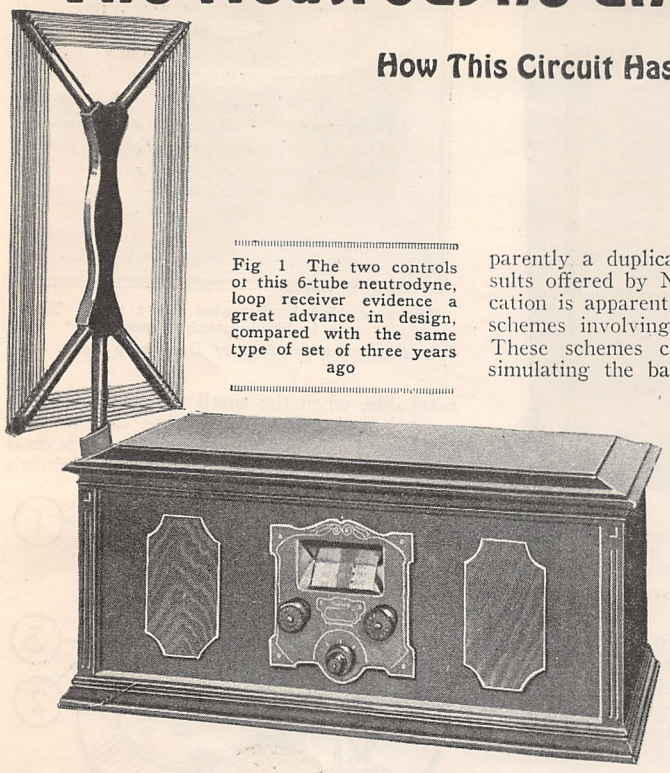


Fig 1 The two controls of this 6-tube neutrodyne, loop receiver evidence a great advance in design, compared with the same type of set of three years ago

GOING back to four years ago, when the Neutrodyne name was applied to Professor Hazeltine's invention of tube-capacity-coupling neutralization, which supplanted almost over-night most of the then existing types of radio receiver, we can recall the extensive flattery evidenced in the innumerable imitations, which shortly flooded the market. These carried various names terminating with "dyne," all of which were calculated to rob the Neutrodyne circuit of its just fame and its position in promoting such a broad advance in the art of radio broadcast reception.

Where are these many "dyne" circuits today? Some of them featured by clever opportunists achieved their purpose in promoting a good if not ethical profit for their originators, but it is doubtful if any of them in any way, shape or manner contributed anything to the advancement of the art, or if any of the detailed features involved in their design are featured in modern radio receivers of today.

It will be recognized, of course, that the salient type of tuned radio-frequency transformer, which perhaps was first evolved by Professor Hazeltine in connection with his Neutrodyne invention, has set the pace for the design of practically all tuned radio transformers even as incorporated in present-day receiver construction. In the absence of the ability of non-licensees to legally construct receivers embodying the Neutrodyne principle, the designation "tuned radio-frequency receiver" soon came into being, and is applied today to many grades of receivers, which are being manufactured by a large number of concerns, even some of the leaders, from a standpoint of volume of business.

The function of the capacity neutralization scheme, which is the salient feature of Neutrodyne, is to promote efficiency in the amount of amplification per stage and the overall amplification on a set, to improve the clarity of reception and tone, and to simplify tuning, together with the elimination of radiation.

Of course, similar results could be secured, which to the unsophisticated are apparently a duplication of the favorable results offered by Neutrodyne, but this duplication is apparent only, because of so many schemes involving so-called "silent tuning." These schemes can only be construed as simulating the basic idea, which Professor Hazeltine has so adequately achieved in his Neutrodyne invention. They involve the use of resistances, inductances, etc., and possibly combinations thereof in various places in the circuit. It will be recognized by scientific analysis and can readily be demonstrated by scientific measurements that these schemes involve electrical losses, which in turn impair the efficiency of the receiver equipment. Neutrodyne, and Neutrodyne alone, stands as the one and only method of definite capacity coupling neutralization with loss of efficiency.

MINUTENESS OF RADIO QUANTITIES

To say that a man walking slowly travels at the rate of sixty feet a minute, is something which can be readily understood. If we divide by sixty and say a man is going one foot a second, we are dealing with quantities, which to the average mind, are too small to permit of proper conception of the rate of speed involved. Now, if we divide this still further by a thousand, and state that a man is going at the rate of one-thousandth of a foot in one-thousandth of a second, it requires a semi-technical mind to properly conceive it.

How, then, can we expect the lay mind to conceive the physical quantities involved in radio, when we must divide by millions, tens of millions, and hundreds of millions, and must talk of frequencies of 300 million cycles per second, and electrical currents of but a minute fraction of a milliampere?

It has been stated that an efficient receiver will respond to a signal strength on the antenna of energy of such small amount, that when multiplied by ten million it will still be less than the energy consumed in the ordinary 25-watt lamp, encountered in practically every house.

Could you conceive dividing the energy in a lamp by ten million? Consider then the extent to which this minute element of energy must be conserved through every portion of the receiver, and which must be carefully guarded against losses of any nature, in order that the signal may be properly amplified to the point, where it can be reproduced as music, through the reproducing device, be it a cone speaker or otherwise.

Yes, it must be conceded that Neutrodyne, and Neutrodyne alone of all the types of so-called T.R.F. receivers, fully conserves this energy, permits it to be amplified without distortion, and efficiently reproduces what the antenna receives.

NEUTRODYNE CIRCUIT A BASIC ONE

The stereotyped five-tube radio receiver, which was immediately popularized with the advent of Neutrodyne, has formed the basis of perhaps 95% of the commercial radio receivers placed on the market during the last three years. Remarkable indeed has been the proficiency with which this basic five-tube design has been evolved by several Neutrodyne manufacturers into a highly efficient, low-priced instrument—an instrument which no amount of money could have procured a few years ago.

But not here did Neutrodyne stop, because it was recognized immediately upon release of Professor Hazeltine's invention, that here was an instrument, which would permit the use of an unlimited number of stages of tuned radio amplification.

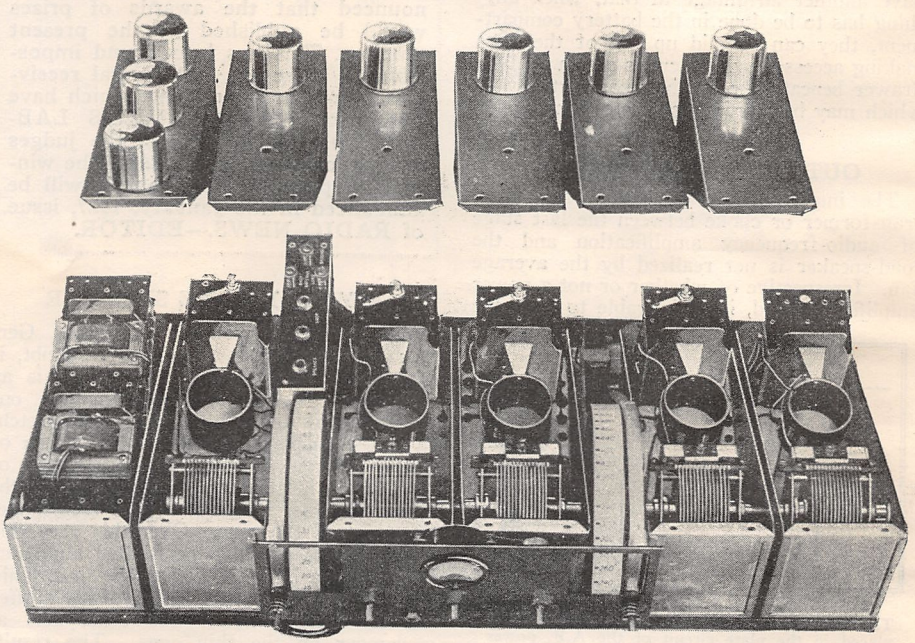


Fig. 4 An eight-tube tuned-radio-frequency receiver which is completely shielded, and is extremely easy to tune and control.

* General Manager, F.A.D. Andrea, Inc.

To achieve more than two such stages, however, which was the basis of practically all five-tube construction, it was soon recognized that special mechanical arrangements were essential. For quite some time engineers of leading companies have been working on "shielded" construction to permit the efficient use of the true Neutrodyne principle on multiple-stage radio-frequency receivers.

While the 1925-1926 season saw limited progress along these lines, it is nothing short of astounding to note the progress that has been made for the 1926-1927 season by practically all the leaders in the industry. Not stopping at three stages of tuned radio construction, they have gone beyond this to four stages, and clever indeed are the mechanical arrangements involved.

RECENT PROGRESS

By "shielded" we do not refer to those receivers which have a metallic cabinet, nor to those having a metal plate across the top or along one side. Neither do we refer to those radio sets which have individual-stage shielding on the high-frequency side, but no shielding on the audio side. It is true that nominally sets such as these are "shielded," but they do not fully accomplish the intent of shielding.

True shielding, by which is meant total individual-stage shielding, when properly and fully used promotes selectivity and sensitivity, and contributes materially to tone quality or reproduction by enforcing the segregation of high frequency, low frequency and direct currents in their proper paths.

Whereas a five-tube receiver can give limited results on loop operation, the advent of the receivers with three and four stages of tuned radio frequency have permitted the design of highly satisfactory Neutrodyne receivers, giving all the selectivity and sensitivity one could desire and with loop operation. The artistic element of cabinet design has, of course, kept pace with improvements in technical design of the receiver mechanism.

To keep apace with the receiver design, from a standpoint of both technical merit and artistic appearance, there have also been broad advances in the sound reproducing designs, or what are commonly known as loudspeakers.

With the advent of the cone speaker, it was recognized that here was a basic principle, which would permit bringing in "missing notes," particularly those on the lower register. It would assist in the aim of proper reproduction of all notes along the scale and which, when combined with improvements in the audio-frequency transformer design, would give a much truer reproduction of that which was broadcast.

Quality is indeed the keynote of receiver qualifications today, and manifestly the three inherent elements of the receiver, namely, the tubes, the receiver proper, and the loudspeaker, must all properly co-ordinate their results to permit achieving the desideratum.

As exemplifying the latest developments from a standpoint of both artistry and technical efficiency, there is illustrated in Fig. 1 a modern six-tube Neutrodyne receiver adapted for loop operation. It will be noted that this instrument is of the two-dial control type; a right-hand dial permitting direct adjustment to the wavelength of the station desired, and a left-hand dial for refinement of tuning to bring in the station with proper volume and clarity. This is a fully shielded receiver, as will be noted from the internal arrangement (Fig. 2), which shows the shields in place. Fig. 3 shows the details of the mechanism with the shields removed.

Three stages of tuned radio frequency neutralized, and two stages of audio frequency, with special filter circuit to permit the use of the latest developments in power tubes, results in an instrument, giving all the desired volume and sensitivity, which one would ordinarily require.

To show further the extent to which the Neutrodyne receiver has been developed to meet modern conditions, there is illustrated in Fig. 4 an eight-tube loop-operated set with four stages of tuned radio frequency, detector, and three stages of transformer-coupled audio-frequency amplification. This illustration shows the internal construction with the shields removed.

Yes indeed, Neutrodyne has played an important part, in fact may be said to have led the way in modern radio receiver development, and the 1926-1927 designs have shown a most salient advance from a standpoint of appearance as well as performance.

MAKE THIS A RADIO CHRISTMAS

EVERY year about this time families gather in conclave and the annual question arises, "What shall we give to Him (or Her) for Christmas?" This year the question is a great deal easier to answer than heretofore. Why? It is really simple: if the person under consideration has a radio receiver, there is doubtless something, a horn or cone speaker of an improved type, a power tube for the last stage of audio, a "B" eliminator or any of the 1,001 new improvements or conveniences of radio, too many to list, that will gladden his heart when he finds it in his "stocking."

Then if the friend or relative has NOT a radio set, the question is even simpler—what better gift could be presented than a source of entertainment that will recall the donor every time it is enjoyed? We know of none. Radio receivers of all prices can now be purchased, so there is nothing in that to prevent giving one.

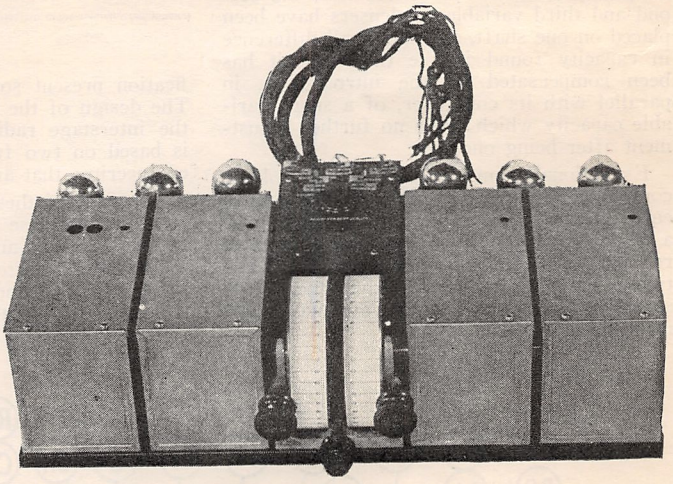


Fig. 2. Here is the appearance of the six-tube neutrodyne receiver, illustrated on the opposite page, when it is removed from its cabinet. The metal shields completely isolate each of the radio-frequency stages of amplification, making the operation of the set more stable.

(Photos courtesy of F.A.D. Andrea, Inc.)

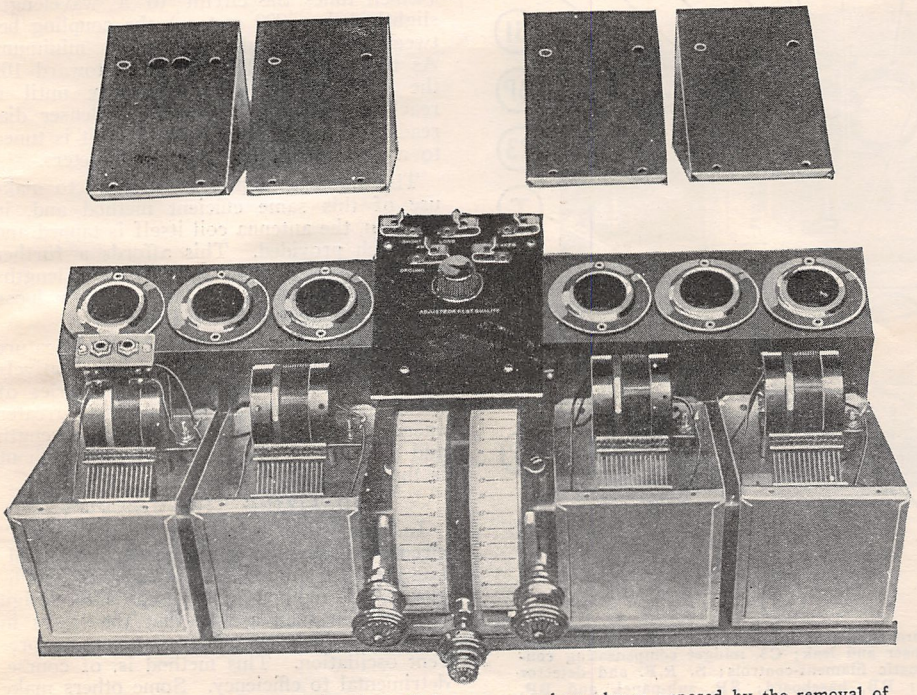


Fig. 3. The coils and condensers of the R.F. stages are here shown exposed by the removal of the top sections of the shields.

ALL THE LITERATURE THERE IS

Scientific students will revel in a compilation just made by the Bureau of Standards listing practically all the recent current literature on technical radio. Topics covered are: radiation; transmission phenomena; fading; daily variations, seasonal variations; directional variations; ionization, Heaviside layer; meteorological; reflection, refraction, diffraction; transmission, theories, formulas, range; eclipses; wave front angle; strays; and measurement of signal intensity.

The compilation is known as Bureau of Standards Letter Circular No. 207.

Constructing the Shielded Hammarlund-Roberts Receiver

A T.R.F. Set with Excellent Selectivity Over the Broadcast Range

By V. T. BAIRD

IN theory this 5-tube receiver is comparatively simple; it combines the selectivity and sensitivity of two tuned-radio-frequency stages, which have been designed to insure an extremely high degree of amplification, with the inherent stability and distortionless characteristics of a non-regenerative detector.

To step-up the signals to loud-speaker intensity, there is used a two-stage transformer-coupled audio amplifier; the transformers used have high primary impedance, and are designed to insure faithful reproduction of the *lower-frequency* tones of music and speech. Their secondaries are wound by a special process, so that their distributed capacity is reduced to a minimum, and therefore the *higher frequencies* and their harmonics are passed on without loss to the loud-speaker. The result is the reproduction with full life and brilliance of the higher musical tones of such instruments as the violin, and the absence of the dull and muffled effects so often found in loud-speaker reproduction.

The tuning controls have been reduced to two, although the receiver has three radio-frequency circuits. To effect this, the second and third variable condensers have been placed on one shaft, and the small difference in capacity found in the third circuit has been compensated by the introduction, in parallel with its condenser, of a small variable capacity which needs no further adjustment after being once set.

Exceptionally smooth and gradual volume control, allowing the operator to adjust with equal facility for a powerful local station or a weak distant one, is provided by a rheostat regulating the filament temperatures of the two R.F. tubes. Those in the other three stages are made uniform by automatic filament controls.

THE HOOK-UP

Fig. 1 shows the circuit employed. Interaction between the fields of the first three stages is prevented by shielding the second R.F. and detector, thus stabilizing the amplification and increasing its efficiency. No shielding of the first R.F. stage is deemed necessary by the designers; although the set is so arranged that the constructor may include this extra precaution if he so desires.

DESIGN OF THE R.F. AMPLIFIER

The two stages of radio-frequency amplification present some rather novel features. The design of the antenna coupling coil and the interstage radio-frequency transformers is based on two fundamental laws of radio engineering, that are as old as radio itself.

The first of these is, that up to a certain point an increase in the coupling between two coils affords an *increase in energy transfer* and a *decrease in selectivity*. The second law is, that the energy transfer between two coils, such as the primary and secondary of an ordinary radio-frequency transformer, *increases rapidly as the frequency increases.* In other words, the energy transfer is much greater at high frequencies (short wavelengths) than at low frequencies (long wavelengths); while the relative selectivity is less at high frequencies and greater at low frequencies. Conversely, a constant transfer of energy and constant selectivity can be maintained by loosening the coupling as the frequency is increased.

A successful broadcast receiver must be capable of receiving wavelengths from 200 meters (1,500 kc.) up to 545 meters (550 kc.), the two extremes of the broadcast range. These requirements make it evident that some means of *variable coupling* must be provided if we are to obtain equal energy transfer and selectivity throughout the broadcast band. Since the trend in modern broadcast receivers is toward simplicity of tuning, the addition of variable coupling controls is not advisable. Therefore there was developed for this set a radio-frequency transformer in which the coupling between the primary and secondary coils is *automatically* varied by the rotation of its associated tuning condenser.

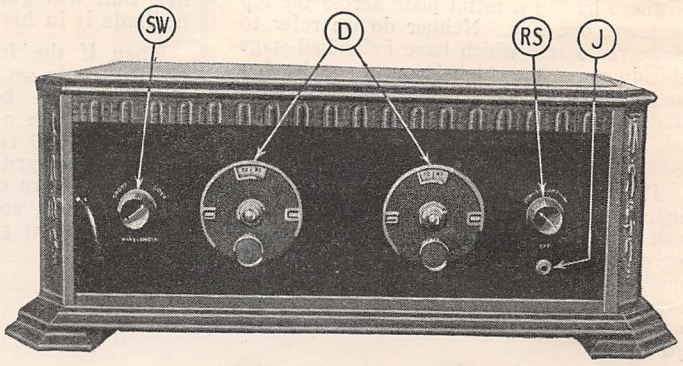


Fig. 2. The tuning of the receiver shown at the right is very simple, as there are only two dials, D, to adjust. The right dial controls two condensers mounted on the same shaft. SW is the antenna correction switch; RS is a combination filament switch and rheostat, and J is the loud-speaker jack.

This variation in coupling is smooth and continuous and is accomplished by means of a cam on the variable condenser shaft. At the setting of 0 on the condenser dial (which tunes the circuit to a wavelength slightly below 200 meters) the coupling between primary and secondary is minimum. As the tuning dial is advanced toward 100 the coupling increases gradually until it reaches maximum when the condenser dial reads 100, at which time the circuit is tuned to a wavelength of about 560 meters.

The antenna coupler is designed to make use of this same efficient method and, in addition, the antenna coil itself is tapped and a switch provided. This affords a further coupling variation to suit different lengths of antennae and to provide extremely loose coupling in very congested areas.

This automatic variable coupling feature makes it possible to use a comparatively large number of turns in the primaries of the R.F. transformers, which causes greater energy transfer. Increased signal strength and a high degree of selectivity throughout is thus obtained.

EQUALIZING THE CIRCUITS

In most of the so-called "self-balanced" circuits, elimination of the tendency to oscillate has been attained at the sacrifice of efficiency. A method often used is to design the coils in such a way that the losses in them introduce enough resistance to prevent oscillation. This method is, of course, detrimental to efficiency. Some others make use of very low plate voltages in the R.F.

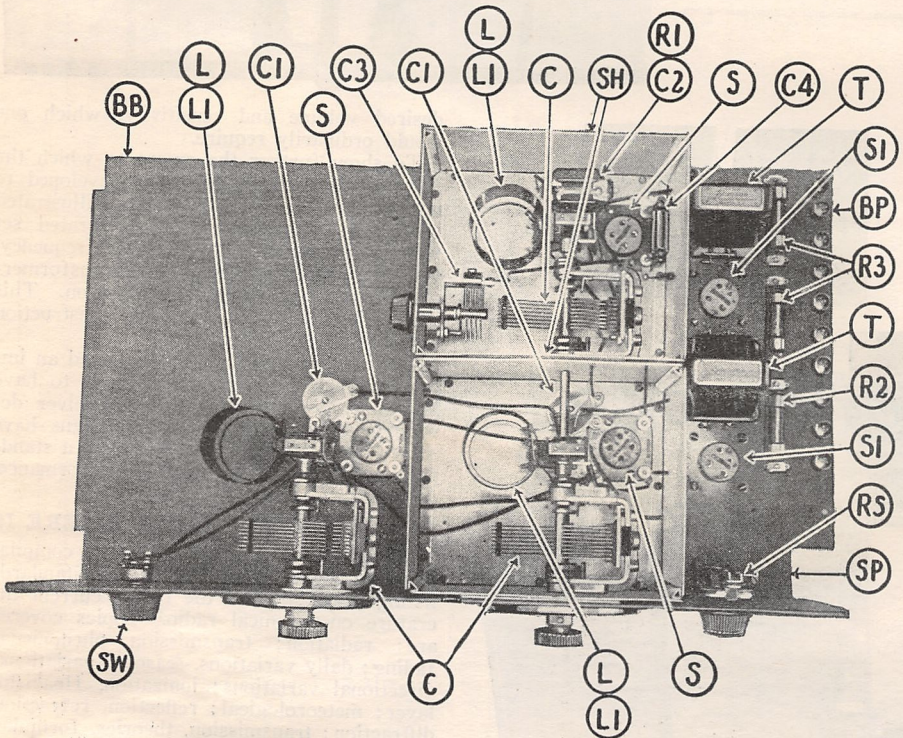


Fig. 3. In this top view of the assembly, L, L1 are R.F. transformers; C, tuning condensers; C1, equalizing condensers; C2 and R1, grid condenser and leak; C3, midget compensating condenser; C4, by-pass condenser; R2 and R3, automatic filament-controls; S, R.F. and detector sockets; S1, A.F. sockets; T, A.F. transformers; BB, baseboard; SP, sub-panel, and BP, binding posts.

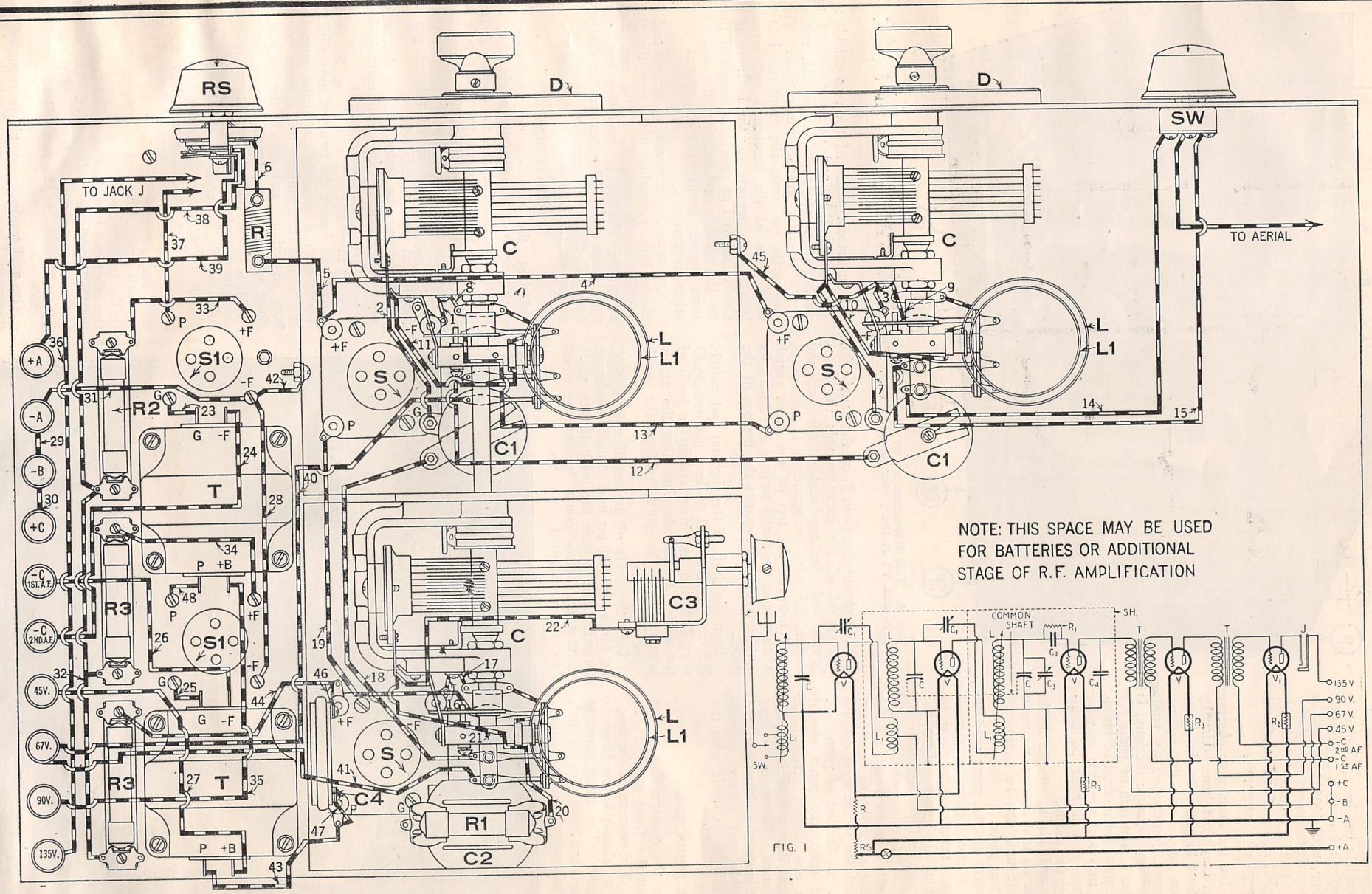


FIG. 1

Fig. 6. This layout scheme of the new Hammarlund-Roberts receiver is lettered to correspond with the list of parts given elsewhere: C indicates the variable condensers, two of which are so connected that they are controlled by the same dial; L and L1 are the inductances attached to the condensers; C1, equalizing condensers; C2 is the grid condenser; C3 the compensating condenser; C4 is a .001-mf. fixed condenser; S are the R.F. and detector sockets; S1, the A.F. sockets; RS is a combination filament switch and rheostat; SW is the antenna-correction switch; R1 the grid-leak; R2 and R3 are automatic filament controls; R is a 2-ohm resistance; and T indicates two 3:1-ratio A.F. transformers. Fig. 1, at the lower right, is the schematic circuit diagram, placed here for convenient reference.

stages, thus reducing the tendency to oscillate, but again with a consequent lowering of efficiency.

In order to permit the use of more efficient interstage-coupling coils, equalization of disturbing potentials has been effected in this receiver, thereby allowing a higher degree of amplification, with consequent louder signals and greater distance-getting ability, without the usual troubles caused by self-oscillation. Both R.F. stages are equalized.

ASSEMBLY AND WIRING

It will be well for the builder to observe closely the system employed here. Usually it is the custom first to assemble the entire receiver, and then to do all the wiring. Here both are done jointly. This tends toward ease of building, because the hand is not hindered by the obstruction of parts not yet in place. The sectional method of building up the shield makes it possible to wire easily the parts which will later be completely enclosed by the shield.

The assembling and wiring of the audio amplifier as a separate unit is a very simple matter. The whole unit can be completed before mounting it in place.

In the list of parts all the parts used in the assembly have been given a symbol which will facilitate reference to them in assembly and wiring. If you purchase the complete kit, you will be furnished with the panel, sub-panel, shields, condenser-extension shaft, and a few other minor parts, all cut and drilled ready for assembly, to match the other material called for in the first column of "manufacturers" in the list of parts. If other apparatus is used, the panel should be procured plain and drilled accordingly. In the following text it is assumed that the kit parts only are used. Before attempting any actual work, it is desirable that you read through the assembly and wiring instructions so as to familiarize yourself with the processes.

PANEL MOUNTING

The first step in the construction of the receiver is to mount the front panel, P, on the baseboard, BB. The corners of the baseboard are cut out, as shown in the illustration, to fit the cabinet. The front panel is screwed to the baseboard with five ¾-inch No. 3 flat-head wood screws.

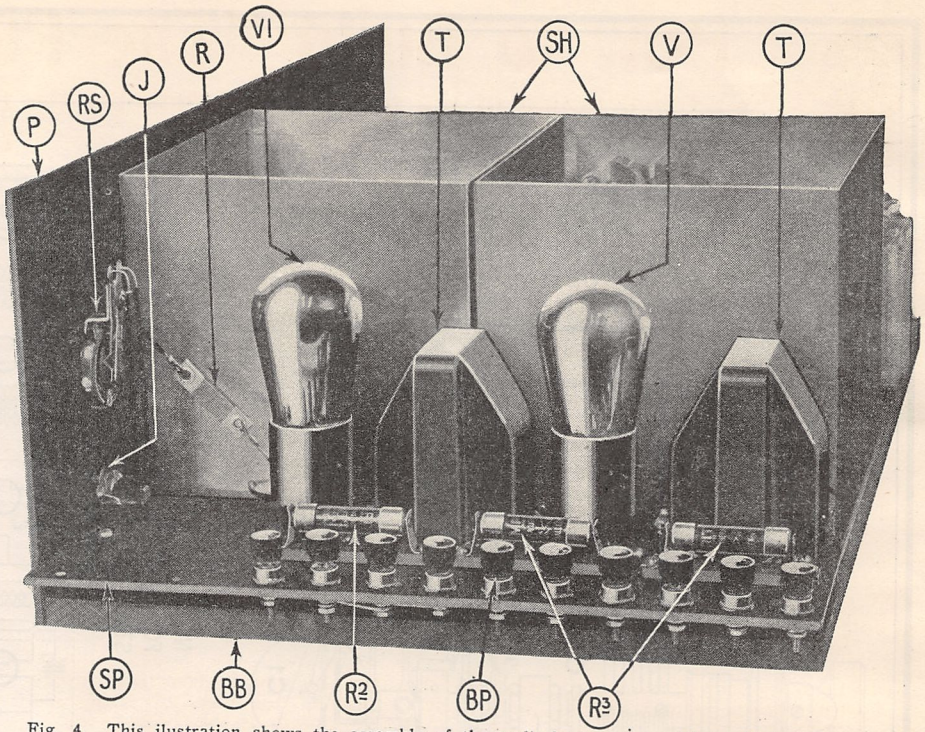


Fig. 4. This ilustration shows the assembly of the audio-frequency amplifier. V is first A.F. tube and V1 is the power amplifier tube. SH indicates the shielding for the R.F. amplifiers.

Next mount the jack, J, on the panel with the spring of the jack towards the baseboard, and the combination rheostat and switch, RS, with the terminals of the instrument towards the top of the front panel. Then mount the aerial switch, SW, with its middle terminals towards the bottom of the panel.

Turn the shaft of the rheostat and switch, RS, as far as it will go in a counter-clockwise direction, and then attach the knob of the switch on the shaft so that the arrow points toward the word "off" on the panel. (See Fig. 2).

Turn the shaft of the aerial switch, SW, as far as it will go in a counter-clockwise direction and attach the knob to the shaft so that the arrow points toward the word "short" on the panel.

The bottom plates of the two shields and the second R.F. and detector sockets are mounted on two metal strips, M, not exposed to view in the illustrations. These two strips run from the front panel to the back edge of the baseboard and serve as braces and supports for the bottoms of the shields, as well as provide a means of lining up the shields and locating the sockets in their proper positions with respect to the other instruments.

Now remove the mounting screws and the single hole mounting nut from the three variable condensers, C. You can throw away the single-hole mounting nut, since this is not used. Also remove the shafts of two of the condensers by loosening the screws on the rotors.

SHIELDING

Mount the aerial-tuning condenser, as shown in Fig. 5, with the shield, SB, between the condenser and the panel. A hole is drilled ¾-inch below the shaft hole on the panel, for the set pin of the vernier dial. Using this hole as a template, drill through the shield, SB, and fasten the set pin of the dial in place in this hole.

Next mount the strips, M, on the under sides of the shields, SH, using eight ⅛-inch 6/32 round-head machine screws.

Now take the three sockets, S, (with bases) and loosen the terminal nuts slightly. Then, with a screwdriver, make sure that the screws that fasten the springs to the base are tight, and mount the sockets in place with machine screws passing through holes in the shields and into tapped holes in the strips under the shield bottoms. The first one is mounted on the baseboard, as shown. One end of the grid condenser, C2, is mounted on the "G" terminal of detector socket with a small strip of brass ⅜-inch wide and about an inch long, having a hole at each end. One end of this is fastened to the under side of the grid condenser and the other end is slipped over and fastened to the "G" terminal of the socket. The socket is then mounted on the bottom of the shield with ⅝-inch 6/32 round-head machine screws.

The grid condenser should be mounted, as shown in Fig. 3, towards the back of the shield compartment to allow clearance for the coil, L, L1.

(Continued on page 684)

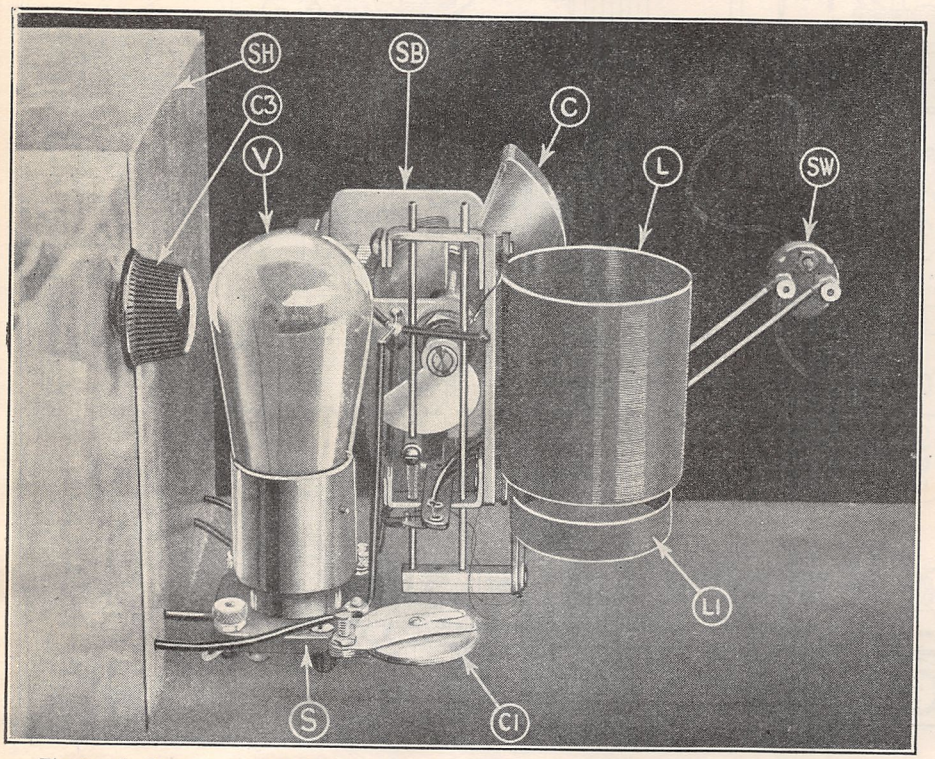


Fig. 5. A close-up view behind the panel. L1 is the primary and L the secondary of the aerial coupler. SB is a shield plate placed between the variable condenser and the panel. The list of parts for this receiver will be found on page 684.

How to Build "The Pianorad"

Construction of the Instrument Combining the Piano and Radio

(Concluded from Nov. Issue)

By CLYDE J. FITCH

WHILE it may appear to the reader at first sight that the Pianorad is a complicated piece of apparatus, this is far from the truth. It is true that 25 vacuum tubes are employed, and radio set builders know very well the amount of labor required to assemble a five-tube set. Consequently the Pianorad is no more complicated than five radio sets; in fact, considerably less so because each tube in the Pianorad is wired like all the other tubes, whereas in a radio set the tubes are all wired differently.

In building the Pianorad, a radio console cabinet was first procured. The illustrations (see page 493 of the November issue of RADIO NEWS) show the type used, and this was found very adaptable, due to the fact that it can be completely closed up when not in use and occupies little space.

Secondly, a two-octave key-board, such as are used by beginners for practice work, was obtained. A set of contact springs was mounted under the key-board in such a way that, when a key was depressed contact with one was made by the spring under the key, which is used to return the latter to its original position when released. In other words, each key acts as a switch and closes an electrical circuit.

But before going into the assembly of the apparatus, let us first discuss the theory of its operation. In the course of our experiments many interesting phenomena were observed and while the reader may have no intention of building a Pianorad, he will undoubtedly find a brief description of its action interesting.

AUDIO OSCILLATOR CIRCUITS

We will start with a single-tube Pianorad; the connections are shown in Fig. 1. All radio set owners are familiar with the high pitched "squeal" sometimes produced by faulty audio amplifiers. It is this squeal, refined to a musical tone, that is made use of in the Pianorad. To obtain it at will, we first procure the windings of an audio-frequency transformer; any one will do. Simply remove the iron core, taking care not to break the fine-wire connections to the coils. The windings are then connected to a vacuum tube as indicated. You will note that the "B" battery current flows through the loud-speaker to the primary winding of the A.F. transformer, and through it to the plate of the vacuum tube. The secondary winding is connected between the grid and filament of the tube.

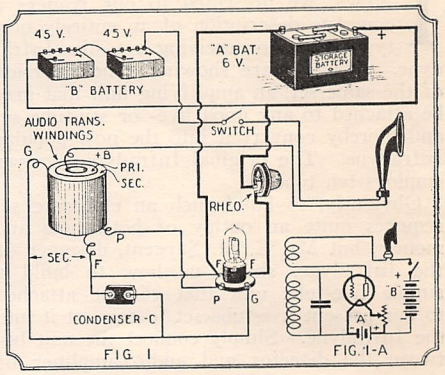


Fig. 1 shows an audio oscillator connected as in the Pianorad, and Fig. 1A is the schematic diagram of the same.

In this case the primary acts as a tickler, and oscillations are generated. Owing to the large amount of wire in the circuit, the oscillations are of an *audible frequency*, and are manifested in the loud-speaker. It is important that the connections to the primary winding be made properly, because if they are reversed the circuit will not oscillate. The simplest way to find the proper con-

(Continued on page 692)

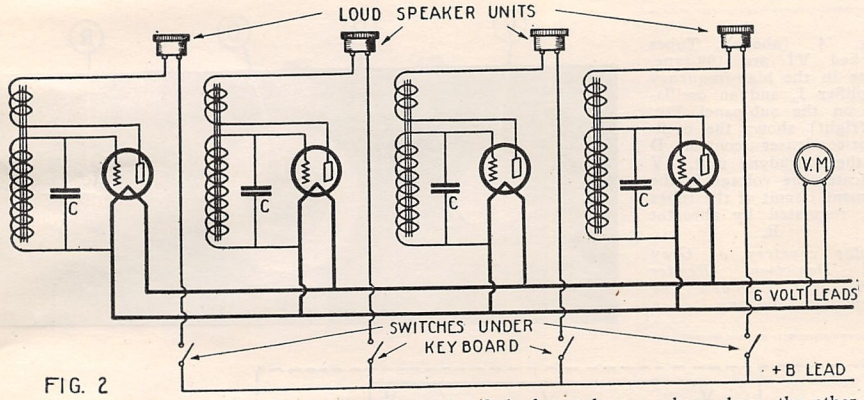


FIG. 2

Connections of the oscillator tubes in the Pianorad. Only four tubes are shown here, the other 21 being wired similarly.

LIST OF BROADCAST STATIONS IN THE UNITED STATES

(Continued from page 629)

Radio Call Letter	BROADCAST STA. Location	Wave (Meters)	Power (Watts)
WKBC,	Birmingham, Ala.	225	50
WKBE,	Webster, Mass.	270.1	100
WKBF,	Indianapolis, Ind.	244	
WKBG,	Chicago, Ill. (portable)	215.7	100
WKBH,	La Crosse, Wis.	249.9	
WKBI,	Chicago, Ill.	220.4	500
WKBJ,	St. Petersburg, Fla.	280	250
WKBL,	Monroe, Mich.	252	
WKBM,	Newburgh, N. Y.	215.7	
WKBN,	Youngstown, Ohio	360	
WKBO,	Jersey City, N. J.	309.1	
WKBP,	Battle Creek, Mich.	265	
WKBQ,	New York, N. Y.	285	8
WKBR,	Auburn, N. Y.	225	100
WKBS,	Galesburg, Ill.	361.2	200
WKDR,	So. Kenosha, Wis.	428.3	
WKIC,	Lancaster, Pa.	258	50
WKRC,	Cincinnati, Ohio	325.9 & 422.3	1500
WKY,	Oklahoma City, Okla.	275	100
WLAL,	Tulsa, Okla.	250	100
WLAP,	Louisville, Ky.	275	20
WLB,	Minneapolis, Minn.	277.6	500
WLBL,	Stevens Point, Wis.	278	750
WLIB,	Chicago, Ill.	302.8	4000
WLIT,	Philadelphia, Pa.	394.5	500
WLS,	Crete, Ill.	344.6	5000
WLSI,	Edgewood, R. I.	440.9	500
WLTS,	Chicago, Ill.	258	100
WLW,	Harrison, Ohio	422.3	5000
WLWL,	New York, N. Y.	384.4	5000
WMAC,	Cazenovia, N. Y.	275	100
WMAF,	Dartmouth, Mass.	440.9	1000
WMAK,	Lockport, N. Y.	365	500
WMAL,	Washington, D. C.	290	500
WMAN,	Columbus, Ohio	286	50
WMAQ,	Chicago, Ill.	447.5	1000
WMAY,	St. Louis, Mo.	248	100
WMAZ,	Macon, Ga.	261	500
WMBB,	Chicago, Ill.	250	500
WMBC,	Detroit, Mich.	256.4	100
WMBF,	Miami Beach, Fla.	384.4	500
WMBI,	Chicago, Ill.	288.3	500
WMC,	Memphis, Tenn.	499.7	500
WMCA,	Hoboken, N. J.	340.7	500
WMRJ,	Jamaica, N. Y.	227.1	5
WMSG,	New York, N. Y.	302.8	500
WNAB,	Boston, Mass.	280.2	100
WNAC,	Boston, Mass.	430.1	500
WNAD,	Norman, Okla.	254	500
WNAL,	Omaha, Nebr.	258	500
WNAT,	Philadelphia, Pa.	250	500
WNAX,	Yankton, S. Dak.	244	100
WNBH,	New Bedford, Mass.	248	250
WNJ,	Newark, N. J.	348.6	150
WNOX,	Knoxville, Tenn.	268	100
WNRC,	Greensboro, N. C.	223.7	10
WNYC,	New York, N. Y.	526	1000
WOAI,	San Antonio, Tex.	394.5	5000
WOAN,	Lawrenceburg, Tenn.	282.8	500
WOAW,	Omaha, Nebr.	526	1000
WOAX,	Trenton, N. J.	240	500
WOBB,	Chicago, Ill.	535.2	5
WOC,	Davenport, Iowa	483.6	5000
WOCB,	Orlando, Fla.	293.7	50
WOCL,	Jamestown, N. J.	275.2	15
WODA,	Paterson, N. J.	390.7	1000
WOI,	Ames, Iowa	270	750
WOK,	Homewood, Ill.	217.3-238	20000
WOKO,	Peekskill, N. Y.	233	50
WOO,	Philadelphia, Pa.	508.2	500
WOOD,	Grand Rapids, Mich.	242	1000
WOQ,	Kansas City, Mo.	278	1000
WOR,	Newark, N. J.	405.2	500
WORD,	Batavia, Ill.	275	5000
WOS,	Jefferson City, Mo.	440.9	500
WOWO,	Fort Wayne, Ind.	227	500
WPAK,	Fargo, N. Dak.	275.1	50
WPAP,	Cliffside, N. J.	361.2	100
WPCC,	Chicago, Ill.	258	500
WPDQ,	Buffalo, N. Y.	205.4	50
WPG,	Atlantic City, N. J.	299.8	5000
WPRC,	Harrisburg, Pa.	215.7	100
WPSC,	State College, Penna.	282.8	500
WQAA,	Parkesburg, Pa.	220	500
WQAC,	Amarillo, Tex.	234	125
WQAE,	Springfield, Vt.	246	50
WQAM,	Miami, Fla.	285.5	750
WQAN,	Scranton, Pa.	250	100
WQAO,	Cliffside, N. J.	361.2	100
WQJ,	Chicago, Ill.	447.5	500
WRAF,	Laporte, Ind.	224	100
WRAH,	Providence, R. I.	235	450
WRAK,	Escanaba, Mich.	256.3	100
WRAL,	Ithaca, N. Y.	365	25
WRAM,	Galesburg, Ill.	244	100
WRAV,	Yellow Springs, Ohio	263	100
WRAW,	Reading, Pa.	238	10
WRAX,	Philadelphia, Pa.	267.7	500
WRBC,	Valparaiso, Ind.	278	500
WRC,	Washington, D. C.	468.5	1000
WRCO,	Raleigh, N. C.	252	100
WREC,	Whitehaven, Tenn.	254	10
WREO,	Lansing, Mich.	285.5	500
WRHF,	Washington, D. C.	256	50
WRHM,	Minneapolis, Minn.	252	50
WRK,	Hamilton, Ohio	270	100
WRM,	Urbana, Ill.	273	500
WRMU,	Richmond Hill, N. Y.	236	100
WRNY,	New York, N. Y.	373.8	500
WRR,	Dallas, Tex.	246	500
WRST,	Bay Shore, N. Y.	215.7	150
WRVA,	Richmond, Va.	256	1000
WSAJ,	Norwood (Cincinnati) O.	325.9	5000
WSAJ,	Grove City, Pa.	229	250
WSAN,	Allentown, Pa.	229	100
WSAR,	Fall River, Mass.	254	100
WSAX,	Chicago, Ill.	268	100
WSAZ,	Pomeroy, Ohio.	244	50
WSB,	Atlanta, Ga.	428.3	1000
WSBC,	Chicago, Ill.	288.3	1500
WSBF,	St. Louis, Mo.	273	250
WSBT,	South Bend, Ind.	315	500
WSDA,	New York, N. Y.	263	250
WSKC,	Bay City, Mich.	261	100
WSM,	Nashville, Tenn.	282.8	1000
WSMB,	New Orleans, La.	319	500
WSMH,	Owosso, Mich.	240	20
WSMK,	Dayton, Ohio.	275	500
WSOE,	Milwaukee, Wis.	246	500
WSRO,	Hamilton, Ohio.	252	100
WSSH,	Boston, Mass.	261	100
WSUI,	Iowa City, Iowa.	483.6	500
WSVS,	Buffalo, N. Y.	218.8	50
WSWS,	Wooddale, Ill.	275.1	1000
WTAB,	Fall River, Mass.	266	100
WTAD,	Carthage, Ill.	236	50
WTAG,	Worcester, Mass.	545.1	500
WTAL,	Toledo, Ohio	252	100
WTAM,	Cleveland, Ohio.	389.4	3500
WTAQ,	Eau Claire, Wis.	254	1000
WTAR,	Norfolk, Va.	261	100
WTAW,	College Station, Texas	270	500
WTAX,	Streator, Ill.	231	50
WTAZ,	Lambertville, N. J.	261	15
WTIC,	Hartford, Conn.	475.9	500
WTRC,	New York, N. Y.	239.9	50
WWAE,	Electric Park, Ill.	384.4	10,000
WWJ,	Detroit, Mich.	352.7	1000
WWL,	New Orleans, La.	275	100
WWRL,	Woodside, N. Y.	258.5	100
2XAD,	Schenectady, N. Y.	22.6-26.2	1000
2XAF,	Schenectady, N. Y.	32.79	10000
6 XBR	(portable)	45-105	250

An Infradyne Combination Set

Adapting the Infradyne Unit to a Standard 5-Tube Set

By CLYDE J. FITCH

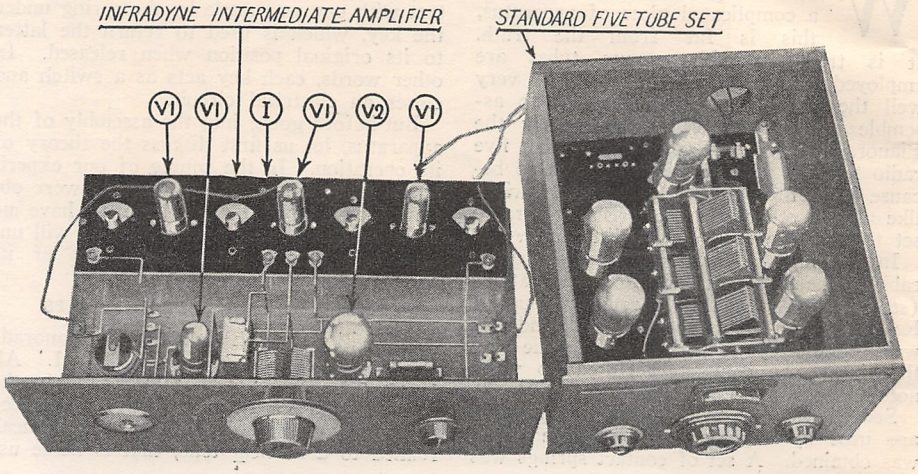
IN the October, 1926, issue of RADIO NEWS, we presented to our readers a complete description of an entirely new type of radio receiving set—the Infradyne. Now we are showing a new version of the same set, an amplifying unit that may be attached to any good five- or six-tube set and thereby convert it into the now popular Infradyne. The original Infradyne receiver employs ten tubes.

Obviously, to build such an elaborate set requires quite an outlay of both time and money; but Mr. E. M. Sargent, designer of the Infradyne, shows us how to build a simple five-tube unit that can be attached to our present five-tube set to convert it into the Infradyne. Simply connect the unit between the detector and audio amplifier of your present set and you have an Infradyne. The unit shown in the various illustrations was built in the RADIO NEWS LABORATORIES, and when connected to a standard five-tube set, gave excellent results.

While the theory of the Infradyne was told in the previous article referred to above, a brief outline of its action will be given here for the benefit of the possible few, who had the misfortune to overlook or miss the original copy.

THE THEORY

The Infradyne is simply another form of superheterodyne. And if you are familiar with superheterodyne action, you will at once recognize the similarity. In the superheterodyne, the incoming radio frequency current is combined with a radio frequency current of a different frequency generated at the receiver by the oscillator tube. And as always has been explained in superheterodyne articles, the two currents of different frequencies set up two beat frequencies, one equal to the difference, and the other equal to the sum, of the two frequencies of the applied currents. In the standard super-



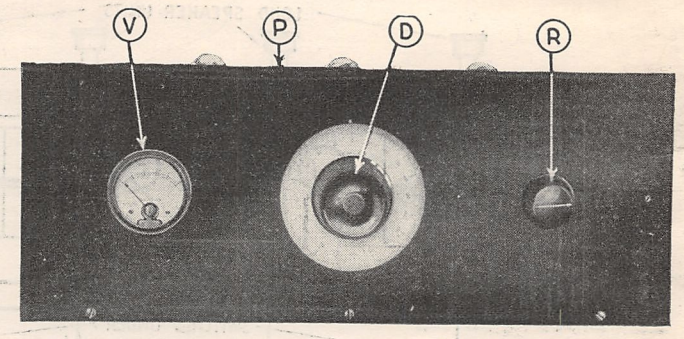


Fig. 4 (above). Tubes marked VI are 199-type, three in the high-frequency amplifier I, and an oscillator on the sub-panel. Fig. 2 (right) shows the oscillator-condenser control D of the Infradyne unit. V indicates the voltage in the filament circuit of the tubes VI, regulated by rheostat R.

Photos courtesy of Gray and Danielson (Remler Div.) Mfg. Co. and The Magnavox Company.

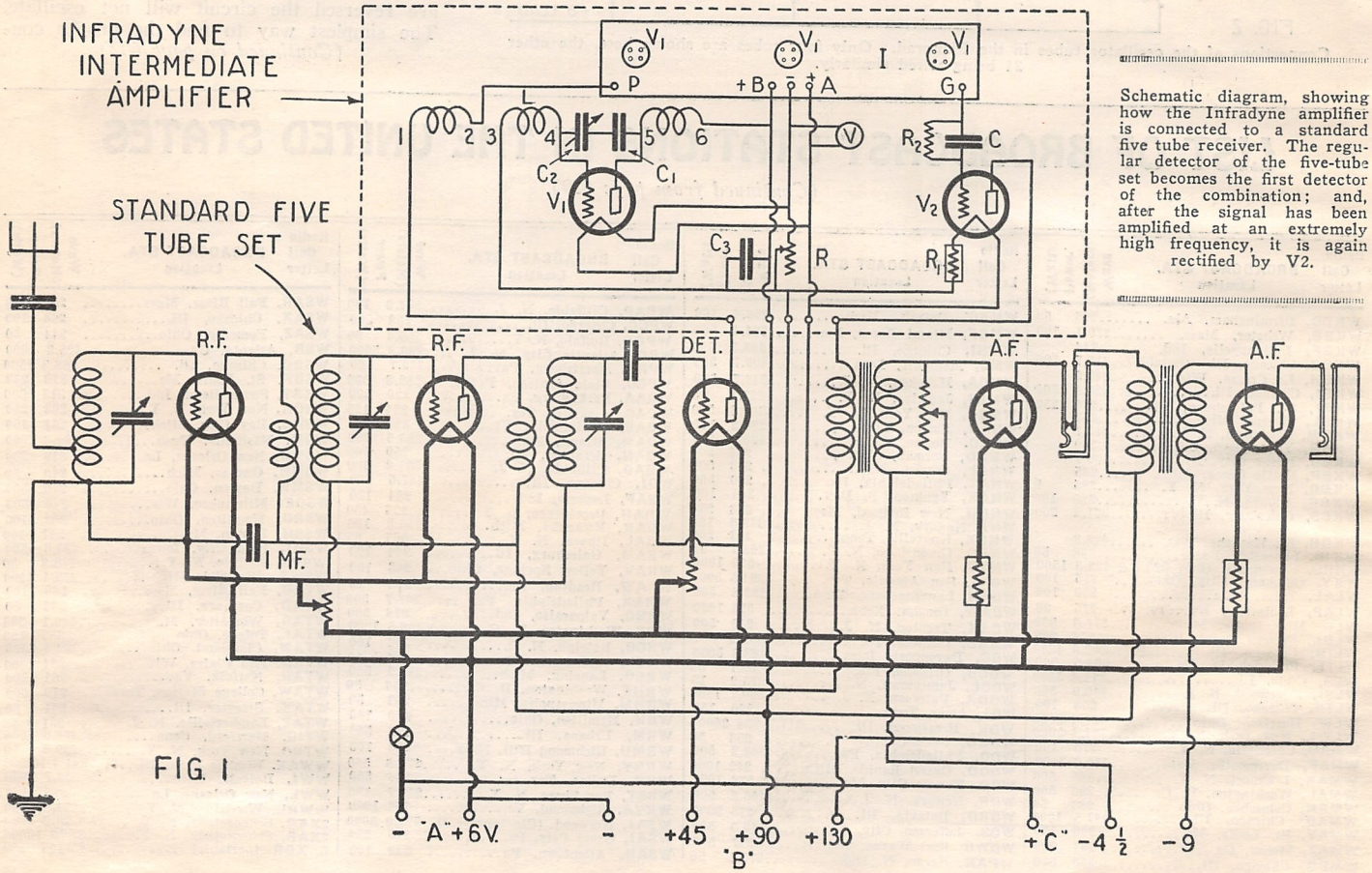


FIG. 1

Schematic diagram, showing how the Infradyne amplifier is connected to a standard five tube receiver. The regular detector of the five-tube set becomes the first detector of the combination; and, after the signal has been amplified at an extremely high frequency, it is again rectified by V2.

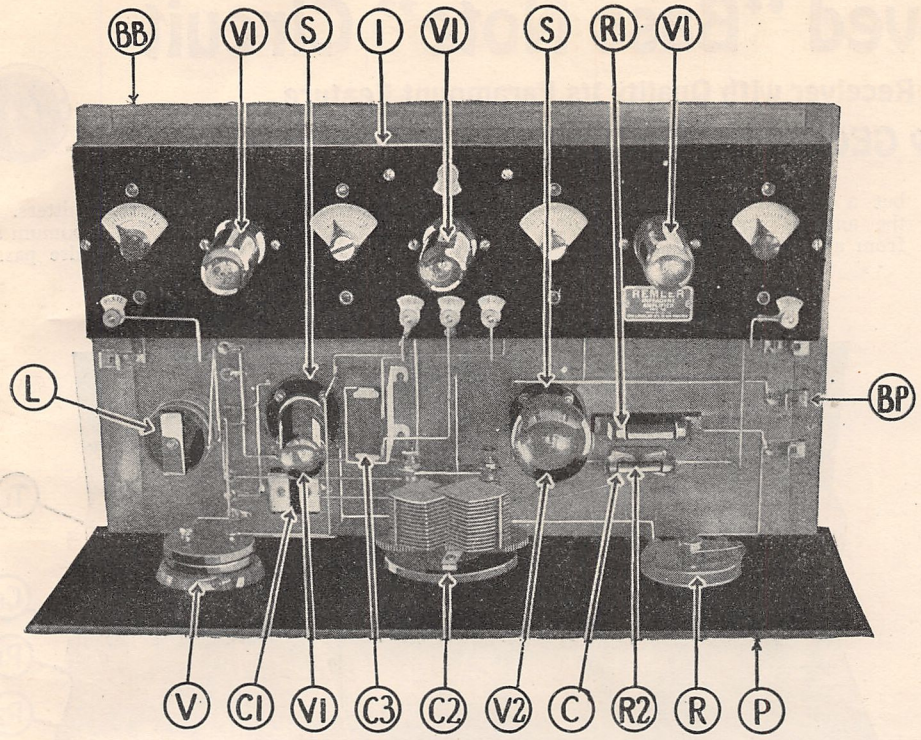


Fig. 3 The top view of the Infradyne amplifier, assembled for connection to a standard five-tube set The symbols are the same as those in the list of parts at the bottom of this page.

heterodyne, the *difference* between the two frequencies is made use of, giving a beat which in practice is in the vicinity of 40,000 cycles per second. In the Infradyne, however, the *sum* of the two frequencies is made use of, and in this particular set the beat produced has a frequency of 3,200,000 *cycles* per second (94 meters wavelength).

In the superheterodyne, the intermediate amplifier is designed to operate on a frequency of about 40,000 cycles. The intermediate amplifier of the Infradyne is designed to operate on a frequency of 3,200,000 cycles.

In the superheterodyne, where the *difference* between the two frequencies is made use of, the frequency of the oscillator must be *increased* while tuning the set to receive waves of higher frequency, so that the *difference* remains constant. In other words, the oscillator condenser dial reading is increased when the tuning condenser dial reading is increased, and vice versa. In the Infradyne, where the *sum* of the two frequencies is made use of, the frequency of the oscillator must be *decreased* while tuning the set to receive waves of higher frequency, so that the *sum* remains constant. In other words, the oscillator dial on the Infradyne is decreased when the tuning dials are increased, and vice versa. The oscillator dial on the Infradyne should have its scale reading backwards, which will aid in tuning and logging stations.

While it has always been known that the sum-frequency as well as the difference-frequency existed in the superheterodyne, the practical utilization of the sum-frequency has been considered such a complicated engineering problem on account of the high frequencies involved, that, until Mr. Sargent developed the Infradyne, apparently no one had the courage to tackle it. Just think of it. An amplifier working at a frequency of 3,200 kc. This is the type of amplifier used in the Infradyne. And to assist experimenters in building their own Infradyne, the amplifier is made available completely wired in one part. It is employed in the apparatus illustrated, and was fully described in the October issue.

BUILDING THE UNIT

The assembly of the complete unit is a very simple task. First procure the parts specified in the list, and proceed to assemble them according to the layout shown in the various illustrations. The sizes of the panel and the baseboard are given in the list of parts, and the drilling, of course, depends upon the parts you select; consequently it is not given. There is only one part which you are to make yourself—the oscillator coil.

THE OSCILLATOR COUPLER

The oscillator coupler consists of three coils wound on a single piece of bakelite tubing 1½ in. in diameter and 2 in. long, as shown in Fig. 5. These coils are of 14, 14, and 8 turns respectively and are all wound in the same direction with No. 24 dsc wire. There should be a space of 1/16 in. between the two 14-turn coils and of 3/16 in. between the 14- and 18-turn coils. Commencing with the 8-turn coil the terminals should be numbered from 1 to 6 as shown in the sketch of Fig. 5, *1* being the outside and *2* the inside terminal of the 8-turn coil, *3* the terminal of the 14-turn coil nearest the 8-turn coil and *4* the other end of this 14-turn coil, *5* the inside terminal of the second 14-turn coil and *6* the outside terminal of this coil.

These numbers correspond with those used in the wiring diagram. To insure operation of the set these directions for coil winding should be followed exactly, particularly as regards their all being wound in the same direction. This oscillator coupler should be mounted in the position shown at L in the illustration, Fig. 3.

The oscillator coil complete, we are now ready to assemble all the parts and start wiring.

WIRING THE UNIT

Fig. 1 shows not only the diagram of connections of the unit but also that of a standard five-tube radio set, employing the conventional two-stage tuned R.F. amplifier, detector and two-stage audio amplifier. The wiring of the Infradyne amplifier unit is shown within the dotted border lines. All the parts employed are marked with symbols corresponding to those in the other illustrations. None of the parts in the diagram of the five-tube set is labeled because any good set may be used and we are not primarily interested in the parts or connections of the set. Therefore, wire the amplifier unit according to that part of the diagram within the dotted lines of Fig. 1, and bring the connections to the unit out of five binding posts, as indicated in the diagram. Only four posts are in view in the photographic illustrations.

The front view of the finished amplifier will look like Fig. 2. On the panel are shown the oscillator condenser dial D, filament rheostat R for the four dry cell tubes, and voltmeter V. The meter is essential, because the 3-volt dry cell tubes are connected

(*Continued on page 726*)

SYMBOL	Quantity	NAME OF PART	VALUE OF PART	REMARKS	MANUFACTURER ★	
C	1	Grid Condenser	.0005 MFD.	With grid leak mounting	1	2, 3, 4, 5
C1	1	Fixed condenser	.0005 MFD.	For oscillator	1	2, 3, 4 5
C2	1	Variable cond.	.00035 MF.	For oscillator	6	7, 8, 9, 10
C3	1	Fixed condenser	1 MFD.	By-pass	11	40, 14, 2
I	1	Amplifier		Remler (special)	6	
V	1	Voltmeter	0-5 D.C.	For 3-volt tubes	12	13, 15
R	1	Rheostat	30 ohms	For 3-volt tubes	16	17, 8, 18, 19, 9
R1	1	Auto. Fil. Cont.	¼ amp.		22	21, 20
R2	1	Grid leak	2 meg.		21	2, 23, 9, 24
S	2	Socket		UX type	25	26, 8, 17, 9, 6
D	1	Dial	4"	For variable condenser	6	27, 8, 28, 29, 9
P	1	Panel	7"x18"x 3/16"		30	31, 32, 33
BB	1	Baseboard	9½"x17"x 5/8"	Hard wood		
L	1	Oscillator coil		Special (see instructions)		
BP	5	Binding posts			34	35, 36, 31, 9
V1	4	Vacuum tubes		3V. dry cell type	37	38, 39
V2	1	Vacuum tube		5V. storage battery type	37	38, 39

NUMBERS IN LAST COLUMN REFER TO CODE NUMBERS BELOW.

1 Sangamo Elec. Co.
2 Electrad, Inc.
3 Micamold Radio Corporation
4 Aerovox Wireless Corporation
5 The Wizard Company
6 Gray & Danielson Mfg. Co.
7 Allen D. Cardwell Corp.
8 Pacent Electric Company
9 Amsco Products, Inc.
10 Gardiner & Hepburn, Inc.
11 Tobe Deutschmann Co.
12 Weston Electric Inst. Co.
13 Jewell Elec. Inst. Co.
14 Potter Mfg. Company
15 Nagel Elec. Co.
16 Central Radio Labs.
17 H.H. Frost, Inc.
18 General Radio Co.
19 Yaxley Mfg. Company
20 Langbein-Kaufman Radio Co.
21 Daven Radio Corporation
22 Radiall Company
23 Arthur H. Lynch, Inc.
24 International Res. Co.
25 Alden Mfg. Company
26 Benjamin Elec. Mfg. Company
27 National Company, Inc.
28 Martin-Copeland Company
29 Kurtz Kasch Company
30 American Hard Rubber Co.
31 Ins. Co. of America
32 Diamond State Fibre Company
33 Dupoint Viscoloid Co., Inc.
34 Fahnestock Electric Co.
35 X-L Radio Labs.
36 H. H. Eby Mfg. Company
37 E. T. Cunningham, Inc.
38 Ken-Rad Corporation
39 C. E. Mfg. Company
40 Dubilier Cond. & Radio Co.
41
42
43
44
45
46
47
48

APPROXIMATE COST OF PARTS $60.00

Form Copyright 1926 E.P. Co.

★THE FIGURES IN THE FIRST COLUMN OF MANUFACTURERS INDICATE THE MAKERS OF THE PARTS USED IN THE ORIGINAL EQUIPMENT DESCRIBED HERE.

An Improved "Bass Note" Circuit

A Sensitive Receiver with Quality Its Paramount Feature

By GEORGE V. ROCKEY

READERS of RADIO NEWS, who have manifested much interest in the "Bass Note" circuit, which was brought out early this year, will find in this article the subsequent changes and improvements which have been incorporated in the receiver by its designer, William T. Taber. The latest and more efficient arrangement is here illustrated and explained. As originally built, this circuit required a three-dial receiver; but the number of controls has been reduced to two, as shown here, by the use of a tandem condenser.

When the "Bass Note" circuit first appeared, its designer announced that there is nothing freakish about it; but that it is designed to add better tone reproduction to the features of other good sets. The following are the main features of the new model:

It incorporates two stages of tuned-radio-frequency amplification, controlled by a potentiometer.

It uses specially-designed solenoid coils (the most efficient—see RADIO NEWS for January, 1926, page 986), which permit no magnetic feed-back and which give the utmost selectivity, sensitivity and volume, with ease of control.

A special balancing condenser, one setting of which is sufficient to cause both dials to read alike over the entire range, and a special compensating condenser, which make both units of the tandem condenser tune to resonance at the same wavelength, are incorporated to minimize the task of tuning.

Resistance-coupled amplification in the audio stages, with provision for a power tube, makes possible tremendous volume without danger of distortion through overloading.

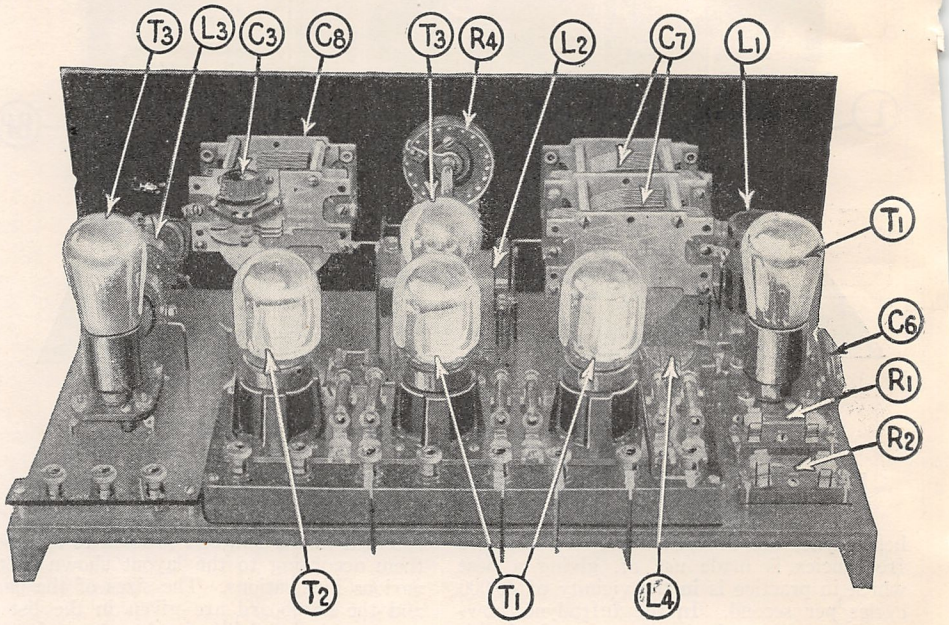
IMPROVED R.F. TRANSFORMERS

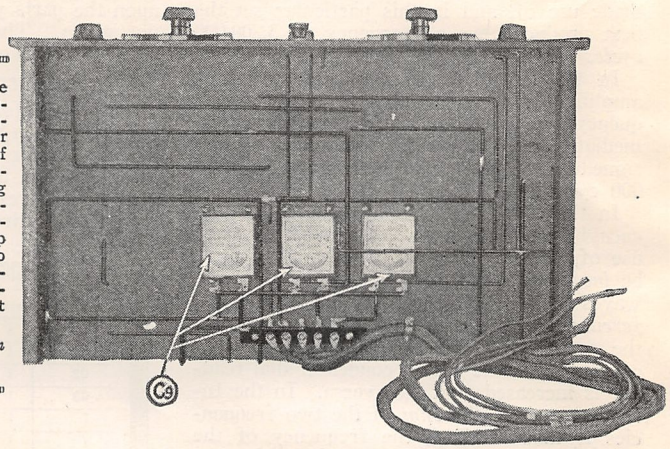
The coils shown in the illustrations, details of which are given on page 740, were especially designed for this circuit, in accordance with the best engineering practice. To obtain sensitivity, it is necessary to have a coil of reasonably low radio-frequency resistance, as well as a minimum of distributed capacity; further, there must be the proper relation between the turns and inductance of both primary and secondary windings.

To insure selectivity, the coils must have but a small external field; so that when the antenna and ground are disconnected from a receiver, the coils will not pick up local signals from powerful transmitters. In other words, the conditions for maximum selectivity are that the signal impulse passes through the first coil, thence on to the second and third in this exact order, so that each tuned circuit acts as a filter. If the coils were of large dimensions with great external fields, the incoming signals might be picked up by either the second R.F. or detector coils; and in that case the full tuning effect of the preceding circuits would not be obtained.

Another feature of these coils is that, due to their small field, inter-action between the several coils is eliminated. The method of placing these inductances is such as to warrant complete stability.

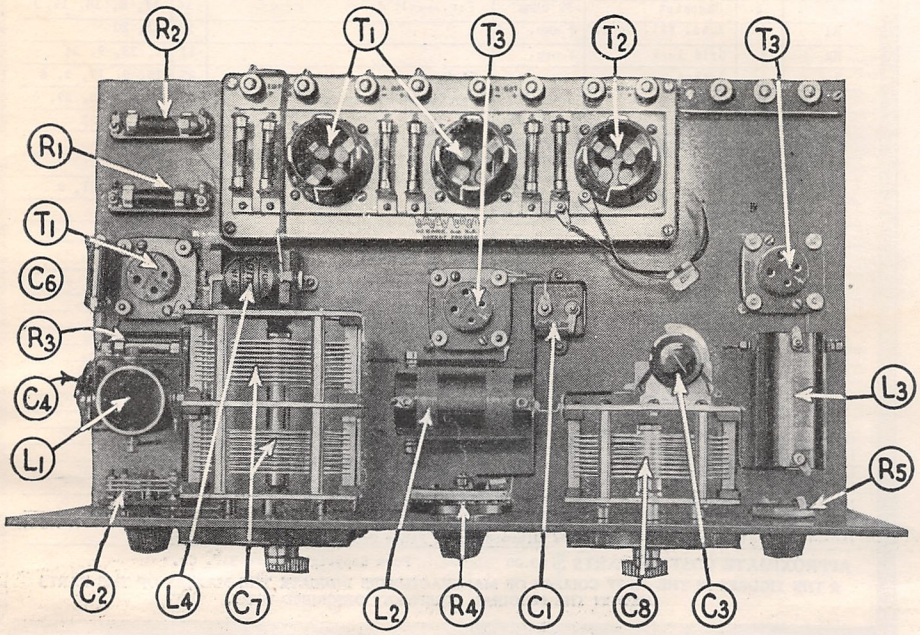
And, to obtain maximum volume, it is necessary to have a proper amount of coupling between the primary and secondary windings; this also affects the over-all selectivity of the set.





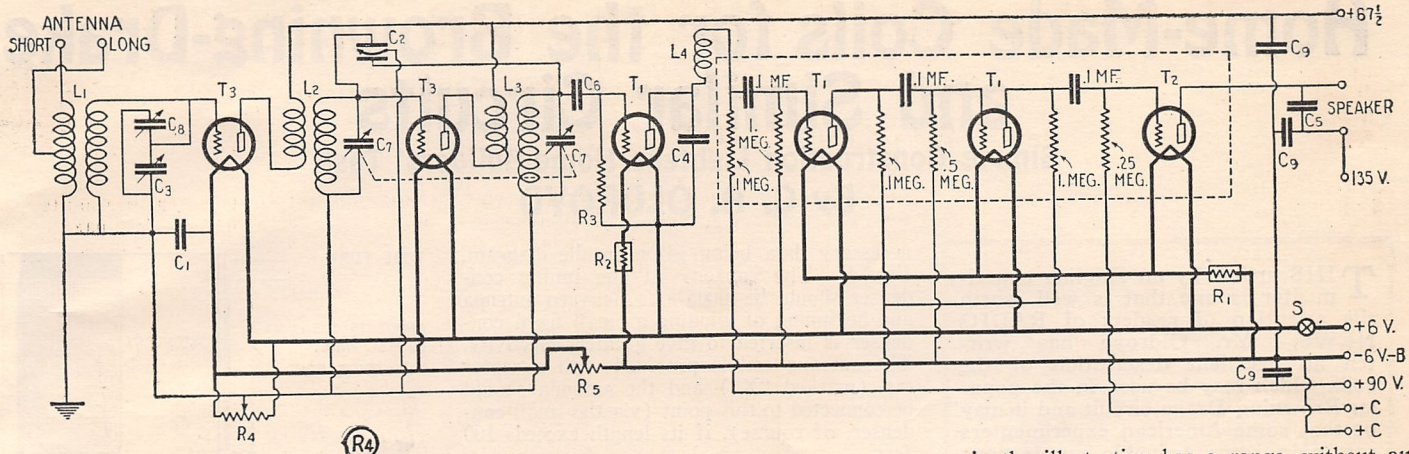
Above: A rear view of the completed "Bass Note" Receiver. The three-stage resistance-coupled A.F.-amplifier unit is mounted to the rear of the baseboard. Right: A bottom view of the set, showing the three 1-mf. by-pass condensers and the battery connector strip. Below: A top view of the set. The two flexible leads on the A.F.-amplifier unit are the "C" battery connections, for the last or power tube.

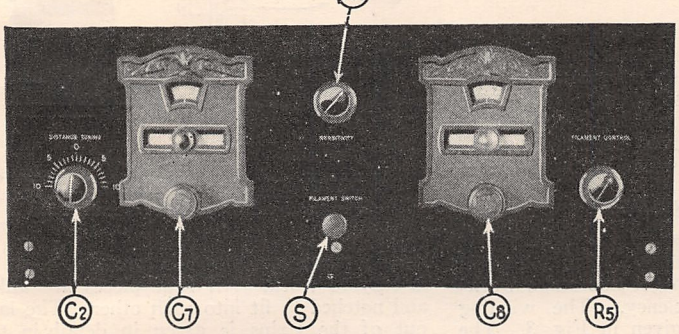
(*Photos courtesy of Daven Radio Corp.*)



COMPENSATING CONDENSER

This special compensator is a miniature split-stator condenser. It is used to balance the capacities in the two radio-frequency circuits, which are tuned by the tandem condensers. These vary slightly, but when receiving distant stations it has been found advisable to correct even such slight differences. The very best condensers have slight





Above: The circuit diagram of the "Bass Note" Receiver. (The value of the third plate coupling resistance should be .1 meg. instead of 1. meg. as indicated.) Left, front view of the receiver, showing the two principal tuning controls, the compensating condenser C2, the filament switch S, the potentiometer R4, and the R.F.-tube rheostat R5.

variations, no two of them increasing in capacity at exactly the same rate as the dial is turned. The coils, also, though very carefully matched, introduce very slight variations in the tuning of the two circuits. Furthermore, the distributed and "stray" capacity, which exists between the wires that connect the condensers and coils of the tuned-radio-frequency circuits, introduces variations; and finally, even though none of these factors existed, the different loads in the two circuits would introduce these variations. Though there appear to be many causes for variations in capacity, each of them is very slight and they are not cumulative.

Such conditions exist whenever two resonant circuits are used together. Therefore, this type of condenser should be used whenever two such circuits are tuned by one dial.

SETTING THE BALANCING CONDENSER

This is a small condenser, used to add to the condenser in the first radio-frequency circuit sufficient capacity to balance that added to the second and third circuits by the compensator. It is attached to the framework of the first R.F. condenser and is tuned only once, after which it requires no further attention.

Because of the compensator, the dial which controls the tandem condensers would read lower than the other when the set is tuned to a certain station; though this difference in reading would not usually be more than four or five divisions on the dial. In order to correct this discrepancy the balancer is used. The set is tuned to receive a station at one of the intermediate wavelengths. After the set has been accurately tuned the dial on the right, which controls the first radio-frequency condenser, is turned to agree with the dial on the left. This will slightly detune the set and it should be brought back into perfect resonance by adjusting the balancer.

When this adjustment has once been made, the settings of the panel dials will be the same over practically the entire broadcast range, and the balancer requires no further adjustment.

RESISTANCE-COUPLED AMPLIFIER

No method of audio amplification, except resistance coupling, can be used if the name of the circuit, the "Bass Note," is to be correct; as no other system of audio amplification has the same straight-line "curve of amplification." The particular unit as shown in the illustration has a range, without audible distortion, from 25 to 15,000 cycles.

The unit shown is wired for a power tube in the last or output stage, and also for a "C" battery, in order to cut down the consumption of "B" current when the power tube is used.

As resistance-coupling does nothing to boost the signal, except through the "voltage ratio" of the tube itself, it is of vital importance to use "high-mu" tubes in the first two stages of the amplifier to secure the proper volume.

Constructors should use parts similar to those listed here; otherwise efficiency in operation may be considerably affected.

(*Continued on page* 740)

SYMBOL	Quantity	NAME OF PART	VALUE OF PART	REMARKS	MANUFACTURER ★	
L1,L2,L3	3	R.F.Trans.			1	
	1	Amplifier		Resistance coupled	1	43,44,45,46,16
T1	3	Hi-Mu tubes		Mu 20 to 40	1	25,26
T2	1	Power tube			1	6,24
R1	1	Auto.Fil.Control	1¼ amp.		1	8,10
R2	1	Auto.Fil.Control	¼ amp.		1	8,10
R3	1	Resistor	2 meg.		1	42,16
	1	Resis. mounting		For 2 meg. resistor	1	42,16
C1	1	Fixed condenser	.1 Mf.		1	3,13,16,17,37
L4	1	R.F.Choke			2	14,15
C2	1	Condenser	35 Mmf.	Compensating	1	
C3	1	Condenser	25 Mmf.	Balance	1	
C4	1	Fixed condenser	.0005 Mf.		3	16,17
C5	1	Fixed condenser	.006 Mf.		3	16,17,13
C6	1	Fixed condenser	.00025 Mf.		3	16,17,13
C7	1	Tandem condenser	.00035 Mf.	Variable	4	18,19,20,21
C8	1	Single condenser	.00035 Mf.	Variable	4	2,18,19,20,21
	2	Dials		Vernier	5	2,19,22,23
T3	2	Tubes		201-A type	6	24,25,26,28
	3	Sockets		Shock proof (UX type)	7	18,27,29,30
S	1	Filament switch			9	32,33
R4	1	Potentiometer	400 ohms		9	19,34
R5	1	Rheostat	10 ohms		11	34,46
	1	Cable strip		5 terminals	35	
	1	Battery cable		5 conductors	12	33,36
C9	3	Fixed condensers	1 Mf.	By Pass	13	37,38,46,16
	1	Panel		18" x 7" x 3/16"	39	40,41
	1	Sub-base		17¼" x 9¾" x 5/8" (wood)		
	20ft.	Bus wire		Multi-colored	31	

NUMBERS IN LAST COLUMN REFER TO CODE NUMBERS BELOW.

1 Daven Radio Corp.
2 Samson Elec. Co.
3 Sangamo Elec. Co.
4 United Scientific Lab. Inc.
5 Brooklyn Metal Stamping Corp.
6 E.T.Cunningham, Inc.
7 Benjamin Elec. Mfg. Co.
8 Radiall Co.
9 Carter Radio Co.
10 Langbein Kaufman Radio Co.
11 General Radio Co.
12 Belden Mfg. Co.
13 Dubilier Radio & Cond. Co.
14 Silver Marshall, Inc.
15 Radio Engineering Labs.
16 Aerovox Wireless Corp.
17 Micamold Radio Corp.
18 Amsco Products, Inc.
19 Pacent Electric Co. Inc.
20 Gardiner & Hepburn, Inc.
21 Hammarlund Mfg. Co. Inc.
22 Martin Copeland Co.
23 National Co. Inc.
24 Radio Corporation of America
25 Ken-Rad Corp.
26 C. E. Mfg. Co. Inc.
27 Moulded Products Corp.
28 Van Horne Co.
29 Alden Mfg. Co.
30 H. H. Eby Mfg. Co.
31 Acme Wire Co.
32 Bruno Radio Corp.
33 Yaxley Mfg. Co.
34 H. H. Frost, Inc.
35 Universal Insulating Co.
36 Howard B. Jones
37 Tobe Deutschmann Co.
38 Potter Mfg. Co.
39 Insulating Co. of America
40 American H. Rubber Co.
41 Westinghouse Fabricators
42 International Resis. Co.
43 Heath Radio & Elec. Mfg. Co.
44 DeJur Products Co.
45 Sonatron Tube Co.
46 Polymet Mfg. Corp.
47
48

APPROXIMATE COST OF PARTS $ 60.00

Form Copyright 1926 E. P. Co.

★THE FIGURES IN THE FIRST COLUMN OF MANUFACTURERS INDICATE THE MAKERS OF THE PARTS USED IN THE ORIGINAL EQUIPMENT DESCRIBED HERE.

Home-Made Coils for the Browning-Drake and Similar Circuits

Simple Construction Lightens Home Builders' Task

By C. A. OLDROYD

THIS article by an English experimenter is one that is well worth the attention of readers of RADIO NEWS. Mr. Oldroyd has written an excellent description of the coils which may be used in the popular Browning-Drake circuit and it may be that some American experimenters can gain some valuable suggestions for the construction of coils in general. Sooner than cut out any of this article, we are publishing it in two parts. The second installment will be presented to our readers in the January issue.—EDITOR.

PART I

"I SHOULD like to try the Browning-Drake if I had the special coils," recently remarked a friend of the writer, when a new Browning-Drake set was demonstrated to him. The radio fan usually has some condensers lying around, and their capacity is not of great importance, as the coils can be adapted to suit the condensers.

Before we deal with the coils, however, we may perhaps answer the often-asked question: "Is the B.-D. really better than other sets using the same number of tubes?" Quite unbiased, the writer can affirm that it is, as far as his own experience goes. To show the efficiency of this circuit, a personal experience seems worth mentioning.

An experimental two-tuber was hooked up on the "bread board"; the first tube was a R.F. amplifier, the second the detector, no audio amplification being used at all. Yet this set, by no means adjusted to maximum efficiency, brought in on the loud-speaker a broadcast station located nearly seventy miles away. The volume was not great, as might be expected, but sufficient to allow the music to be heard clearly all over a quiet room. Do you know of any other two-tuber without audio that can beat this? Well, then try the Browning-Drake, you won't regret it.

ANTENNA COIL

Now for the coils: In the original design, the antenna coil has only one winding, all necessary data being given in the diagram, Fig. 1. The capacity of the tuning condenser should be .0005-μf. Between antenna and beginning of winding a small fixed condenser is inserted to give greater selectivity. The antenna coil is provided with a center tap (marked "X") and the antenna should be connected to this point (via the small condenser, of course), if its length exceeds 100 feet.

Fans, who prefer an aperiodic primary, may care to try the antenna coil shown in Fig. 2, which has given exceptionally good results in the writer's hands. This coil should be tuned by a variable condenser of about .00035-μf. A few experiments will soon show the right number of turns to use.

R. F. TRANSFORMER

The special radio-frequency transformer is the heart of the Browning-Drake, and great care should be taken to get this stage working at maximum efficiency. The winding data for the coil are given in Fig. 3. The primary is wound in a slot, usually cut in the circumference of a hard-rubber or dry-wood disc. The slot-wound primary lies under the first turn of the secondary, at the end which goes to the "A+" lead.

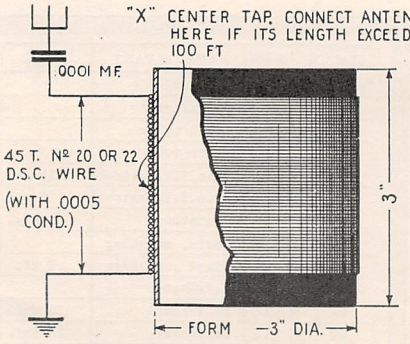


FIG. 1

Above are given the specifications for the antenna inductance. Notice the center tap for antennae over one hundred feet in length.

Here the average set builder is up against a difficulty right away; few of us are fortunate enough to own a lathe on which the groove can be cut. A very satisfactory form can, however, be made from three cardboard discs as shown in Fig. 4.

Two of the discs are just large enough to fit the inside of the form; the third disc is slightly smaller. A small screw clamps the three discs together, the smaller one lying in the center. The completed form is shown in the picture (Fig. 5.) The small strip of hard rubber serves merely as a handle and makes the inserting and removing of the primary very easy; it proved a great convenience in the writer's experimental set. The number of turns given for the primary can be regarded as only approximate, for the best number of turns must be determined by experiment.

A LOW-LOSS COIL

For a more finished coil, the skeleton form illustrated in Fig. 6 will be hard to beat. It is built up from four strips of thin dry wood; cigar-box wood is preferable, as it is easy to work. All four pieces are alike, and notched to fit into each other. The lay-out of the strips is given in detail in the illustration; measure the inner diameter, R, of the tube form used, and draw a circle of this diameter on a sheet of drawing paper.

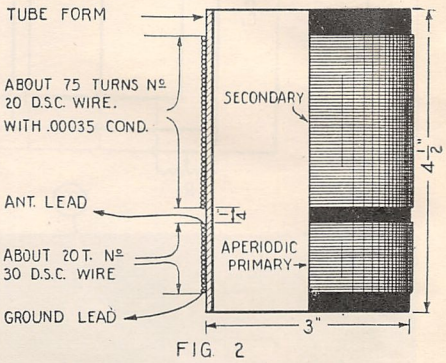


FIG. 2

The antenna coil shown here has an aperiodic primary winding. The secondary is designed to be used with a .00035-mf. condenser.

Divide each quarter of the circumference ("A" in sketch), into three parts, the inner one being twice as large as the two outer. This gives us points C and D. Connect the corresponding points and you have the center lines of the wood strips; draw in the wood strips, and you find automatically the position of the notches.

When the four pieces have been cut and finished, they are glued together. The ends of the arms are finally slotted with a saw to give the winding space. Between the arms, the winding lies free, and is surrounded by air only. We are therefore justified in calling our primary a low-loss coil. The appearance of the completed form is shown in Fig. 7.

Fig. 8 shows the primary in position, inside the end of the R.F. transformer coil. The beginning and end of the winding can be secured by drilling two small holes through the arms of the skeleton frame, the wire is passed through the hole and a turn taken around the outside of the arm.

For an experimental hook-up, it is advisable to solder the ends of the winding to

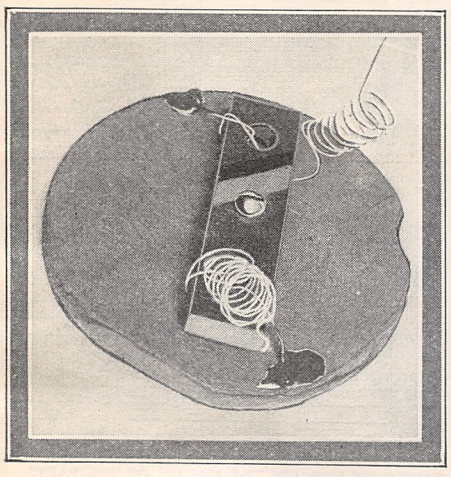


Fig. 5. How the completed primary of the R.F. transformer, when made of cardboard discs, will appear.

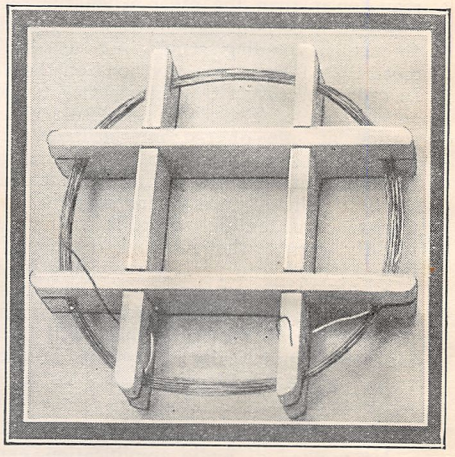
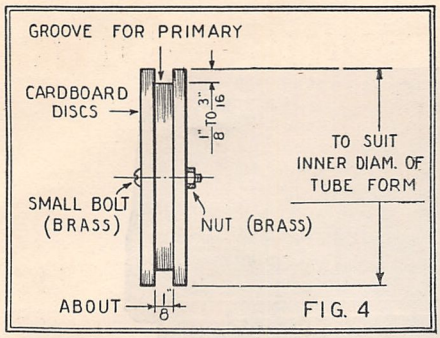


Fig. 7. The primary winding placed in this type of form will be found to be an efficient one. Note simplicity of construction.



The primary of the R.F. transformer can be made from three cardboard discs, as diagrammed above.

short pieces of flexible wire, so that the primary can be removed without breaking a joint. Different colors may be used for the leads to show the beginning and end of winding.

FIXED TICKLER COIL

There remains only the tickler winding To be really efficient and comfortable to adjust, the mounting for the rotating tickler must be well made; and few amateurs will be able to produce a mounting as good as those used by professional coil makers. The best way seems therefore to use a fixed-tickler winding, which does not tax the skill of the set builder to any extent. The data of the winding are given in Fig. 3.

With a fixed-tickler winding, regeneration is controlled by a variable high resistance. This is connected across the ends of the tickler winding; the resistance should be variable from about 400 to 40,000 ohms. A very delicate control is possible with this arrangement.

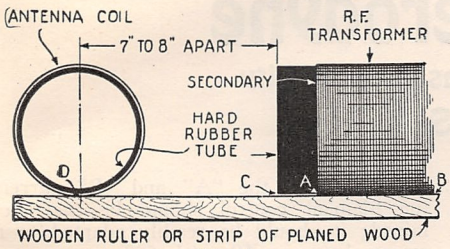


FIG. 10

As indicated in Fig. 9 the coils should be placed at 90° to each other and other information is given above.

NOVEL REGENERATION CONTROL

There is another method of controlling regeneration when using a fixed-tickler winding, which deserves more attention than has been given to it. Our coil is wound as before, the tickler winding being about ¼-in. from the end of the secondary. (See Fig. 3.) A turn of stranded wire, or of thick copper wire, say about No. 14 gauge, is wound in the gap between the two windings, as indicated by "X" in Fig. 3. The ends of this one-turn loop are connected to the terminals of a carbon-pile filament rheostat, having a maximum resistance of about fifty ohms.

When the rheostat is fully "in," offering but little or no resistance, regeneration is at a minimum; with the rheostat fully "out," (having in this condition a high resistance), regeneration reaches its peak. The explanation of this method seems the following:

The secondary winding induces a current in the one-turn loop, the latter transmits energy to the adjoining tickler winding. With little resistance in the circuit (rheostat "in"), no high voltages are built up in either loop or tickler winding.

Higher voltages are induced in the loop and tickler winding as the resistance is increased, for the current must be able to

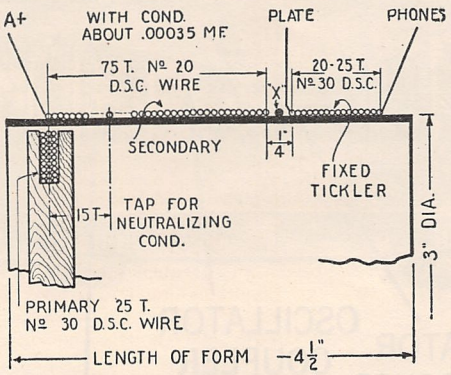


FIG. 3

The heart of the Browning-Drake circuit, the R.F. transformer, is shown here. The primary is wound on a special form.

overcome this resistance to complete its journey. The regeneration effect is accordingly greater.

This method of regeneration control is a severe test for any rheostat, as everything depends upon a smooth and gradual variation of the resistance. A good carbon compression rheostat will, however, be found equal to the task.

In determining the correct number of turns for the tickler, the fan must experiment a little on his own. Much depends upon the tube used and the plate voltage applied.

MOUNTING THE COILS

Our coils are now complete and we can mount them in the set. Fig. 9 shows a set of home-made Browning-Drake coils fixed to the sub-panel. The coils must be spaced well apart to avoid interaction; and their axes must be at right angles to each other. In addition, the centers of the windings should lie in the same plane. (Dimensions for spacing are indicated in Fig. 10.)

The lining-up can be easily carried out if the plan indicated in Figs. 10 and 11 is followed. Fig. 10 shows the coils as seen from above. Place a ruler or wood strip

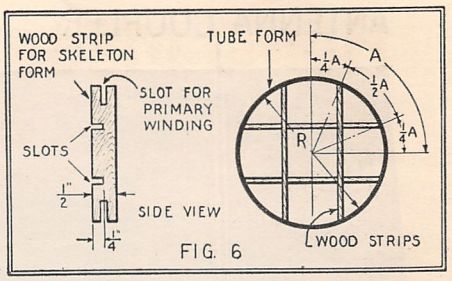


FIG. 6

Specifications for a more substantial primary form for the R. F. transformer. It is indeed simple to construct.

with planed edge against the coils; with the coils in line the rule should touch them at the points A, B, and D. The rule must not lie against point C, for this is the tube form lying slightly below the winding.

It only remains to line up the coils in a vertical direction. Proceed as shown in Fig. 11. Make a cardboard gauge of the shape indicated and hold it first against the antenna coil. Mark the beginning and end of the winding by lines penciled at the edge of the gauge strip. The resulting marks are shown as I and II.

Repeat with the other coil, the R.F. transformer; this will give us marks III and IV. If the coils are located at the right height, the distance from I to III will be the same as that between II and IV. One of the coils must be either raised or lowered until this is the case.

How the writer adjusted his antenna coil can be seen in Fig. 9. It was slightly raised by placing it on a thin wood strip; under the latter lie some small packing

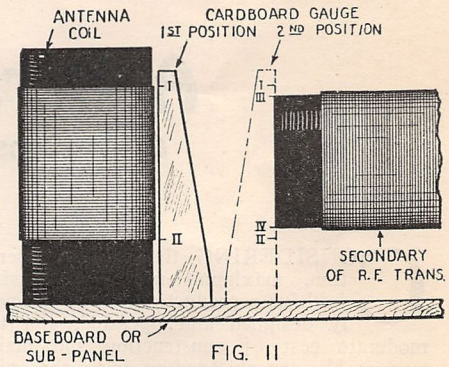


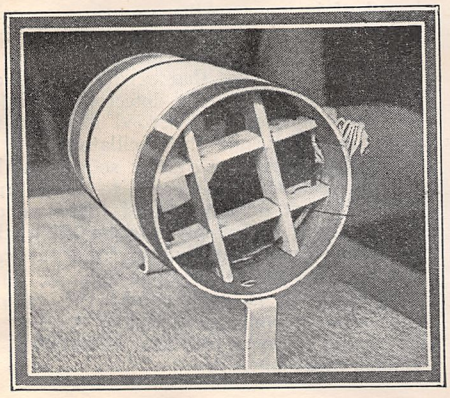
FIG. 11

In order to have the windings of the two inductances in this exact relation the use of a gauge is necessary.

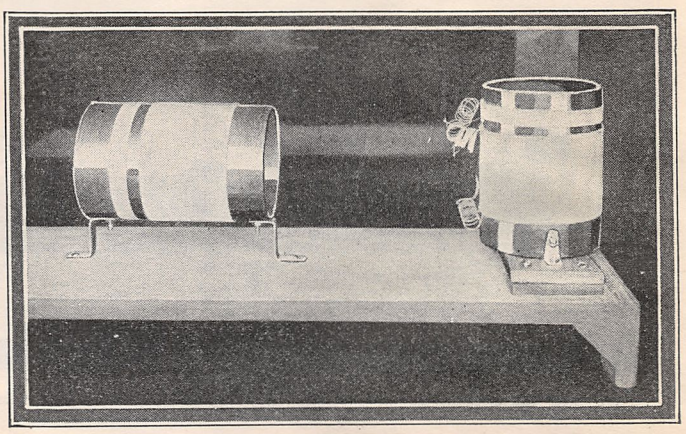
pieces of hard rubber. Wood screws hold the assembly firmly in position.

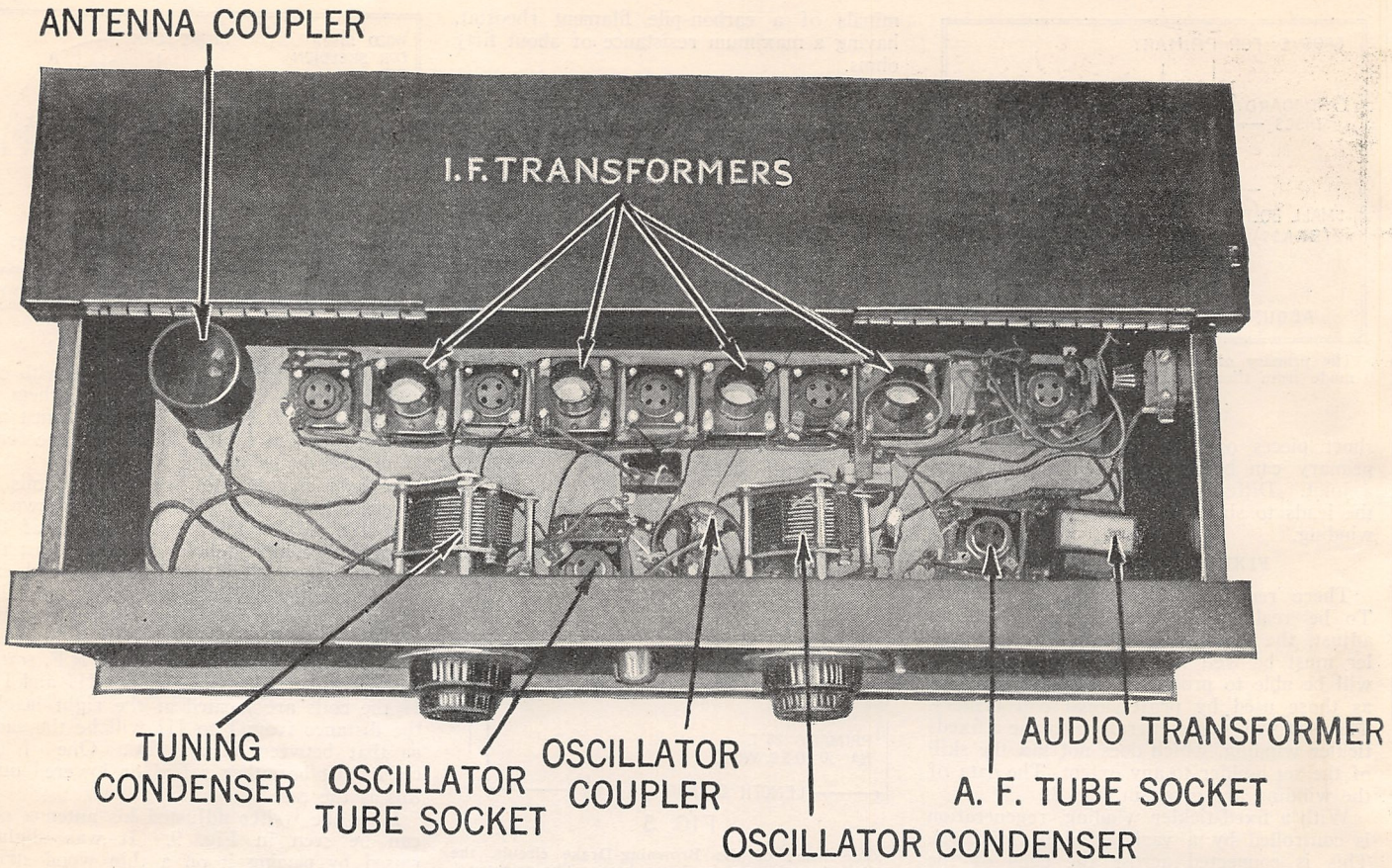
The above hints will enable the interested fan to judge for himself whether the Browning-Drake suits his purpose. Once you have built a small experimental set, you will not be able to resist the temptation to see what a well-built four- or five-tuber can do!

(To be concluded)



We see in Fig. 8 (left) the primary coil and form, shown in Fig. 7, in position within the tube supporting the two other windings. Fig. 9 at the right shows the proper manner of mounting these coils, with the windings at right angles to each other for the reduction of strays.





Clip-leads are used for connections throughout this experimental superheterodyne receiver, so that new circuits and apparatus may be tried with little difficulty, and the original hook-up easily restored in a few minutes, if preferred.

A Versatile Superheterodyne

A Unit-Construction Superheterodyne of Increased Flexibility

By LESLIE RAYMOND JONES

CONSIDERING the ease of operation, maximum useful selectivity, faithful reproduction when properly designed and operated, and the moderate cost of construction and maintenance, the superheterodyne is, in the opinion of most engineers, the ultimate, as far as present broadcast receiving methods are concerned.

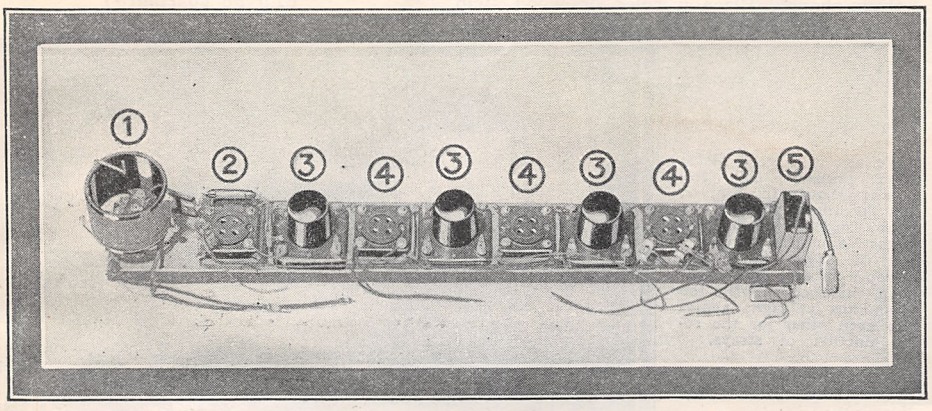
Moreover, the criticism that it is an extremely expensive set to build and operate is, to a great extent, overcome and eliminated by the use of the new 199 and 201-A series of vacuum tubes and the larger types of "B" batteries and "B" battery eliminators now on the market.

The superheterodyne described here is just an ordinary one with a few special features that, while not in themselves new, are relatively little used. Let us consider the main factors that a good set should have. They may be summarized thus:

The constructional details should not be too difficult for the average experimenter and radio fan, who prefers to build his own set. The construction should also be *flexible* to allow *changes* to be made which incorporate new and improved ideas, as well as experimental changes and testing.

It should have efficient compactness; the tuning should be simple and readily calibrated for reference use; it should be economical of the "A" and "B" current; the filament control should be easily obtained; it should be readily adapted to all waves between 50 and 600 meters: It should be adaptable to the popular types of receiving antennas and loops; it should incorporate a powerful audio unit amplifier; it *should* have a maximum of useful selectivity; it *must* have an output of high standard tonal quality; it should give good reception over a range of from 1000 to 3000 miles, depending upon location, etc.

These requirements are all reasonable and are substantially realized in the superheterodyne herein described. Let us now see just how this receiver measures up to these standards.



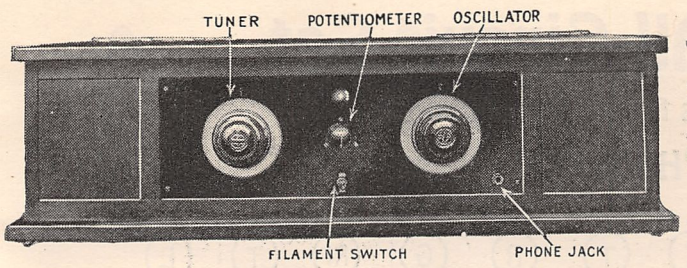
No. 1 is the antenna coupler; 2, the first detector; 3, I.F. transformers; 4, I.F. sockets; and 5 is a by-pass condenser.

UNIT CONSTRUCTION

The flexibility is obtained in this instance by building each unit on a separate baseboard of its own. All connections to other units are made to clips, the method best adapted to this style of construction.

This means then, that separate units are to be built for the first detector, the intermediate amplifier, the second detector, the audio amplifier, and the oscillator.

The big advantage of this scheme is that if, for instance, we decide to try a new kink or stunt on any one of these we can easily do it by simply disconnecting that particular unit, removing it from the cabinet for the work to be done upon it. Upon completion it is replaced in the cabinet, the clips reconnected and the receiver is none the worse for the experiment or change made upon it.



Although the units or parts of this superheterodyne receiver are interchangeable, the controls on the front panel remain the same. The different controls are here indicated.

Is there anything more disheartening to the live experimenter than the realization that as far as changing or trying out any new stunts on his wonderfully finished product is concerned, he is absolutely licked; unless he wants to rip practically the whole thing apart and make it over, as we all have done in the past?

TO THE HEART'S DESIRE

Suppose that, after some elaborate change you have made upon reading some convincing article, which propagated a "new stunt" that "surely" works, you gradually come to the conclusion that it does not seem to work that way for you. What are you going to do about it? You will have to go all over it again, and finally arrive just where you started from.

Now just think how nice it would be simply to open the cover, disconnect two or three wires and—"presto"—the unit comes out and we can change that particular part just as we wish. Back goes the unit and we sit down again and listen to some thrilling aria from the opera while we take up our everlasting search for an improvement or a new "kink", none the worse for our little experiment. And, furthermore, the set is none the worse for it, either. We haven't harmed the panel by drilling extra holes or damaged the balance of any of the other parts of the circuit in any way.

The apparent simplicity of construction is also real. Each unit can be tested and balanced up to its highest point of efficiency.

PANEL ARRANGEMENT FLEXIBLE

Another decidedly worth-while advantage is the panel arrangement. Even as it is arranged here we have enough apparatus on it to adapt it admirably to almost any possible change you wish to make. And in the meantime, the outside of the set is uniformly neat and attractive. On the panel are mounted:

Two .0005-μf. double-section variable condensers; one battery switch; one 300-ohm potentiometer; one pilot light; one single-circuit jack; two dial markers or pointers; two vernier dials, 4-inch type.

The elimination of many parts, such as jacks and switches, will add to the efficiency of the set. Whatever jacks are used, be sure to use the best and thoroughly inspect them for contact and insulation. A good jack should have long phosphor-bronze springs and well defined points of contact, also a flexible action to follow up the spreading or closing action.

With the one-stage amplifier used here and a good loud-speaker, anything that can be heard on the phones clearly can be heard on the speaker, unless extreme distance is desired. In this case either the detector circuit can be tapped by the clips on the output jack or you can plug in directly on the one-stage audio unit. However, it is better to listen in for distance on the detector, using the ear phones if you want to do real work. If the phones are used on the amplifier here described, it will be advisable to cut down the "B" battery to around 90 volts instead of using from 130 to 150 volts. Failure to do this may damage the phones in some cases.

COMPACT AND ECONOMICAL

Compactness is more or less optional; depending on the builder's point of view, so to speak. The set shown in the illustrations is large enough to make a good looking job, and the parts are all amply spaced without being excessively separated.

The tuning is simple, having only two controls. The potentiometer or volume control, also used for sensitivity, is not critical while picking up stations. It can be set and left alone, except on extreme distance. Calibration is readily accomplished if so desired. The dials go step by step very uniformly, varying only two or three degrees over the entire scale.

(*Note.* In order to have this matching up of condensers it is necessary to use coils and condensers of known uniformity; otherwise, the dials will vary more than this amount.)

As far as battery drain is concerned, this set will be found fairly economical, depending upon the balancing and biasing of the different component parts. It draws about 2 amperes from the "A" battery, and approximately 15 milliamperes "B" current, varying with the potentiometer setting, etc.; this is not excessive and the results are well worth it. Properly balanced and operated this "super" will not take, on the average, any more than some neutrodynes and other tuned radio sets, so-called. To prove this, just connect up a milliammeter in the negative "B" lead and measure the respective amounts of "B" current from different sets to which you have access; you will be surprised at the results.

PERMANENT FILAMENT ADJUSTMENT

The filament control is affected by the use of a master rheostat, placed inside of the cabinet and out of the way of meddling hands. There is no quicker way of spoiling your tubes than applying excessive voltage to the filaments. After placing the rheostat inside of the cabinet, the adjustment is made for a setting of approximately 4.5 volts, and then left alone. This requires an accurate voltmeter, the only way of really knowing what voltage is impressed across the terminals of the filaments.

Your tubes will last their maximum life expectancy if used properly, and filament temperature is extremely important in this case. Now, why have all the tubes on one rheostat? Why not have one on each tube? From actual tests and experience the writer has repeatedly found that on superheterodynes this is not at all necessary; in fact it is a waste of time and money. For all practical purposes, one rheostat is sufficient.

Another feature which makes for versatility is the incorporation of plug-in coils. Simply by plugging in coils of proper inductance, wavelengths from 50 to 600 meters are easily received. Many interesting things are going on below 200 meters. If you don't believe it, try it and see; you will find much of interest there. The changes are readily made and there is nothing cumbersome or inefficient in the method, with good parts and care in design.

This set can be easily adapted to indoor or outdoor antennas, or to loops of popular types. All variations can be used with apparently equal success, by slight changes to facilitate their adoption.

ONE A.F. TRANSFORMER SUFFICIENT

Now for the audio amplifier: if your "super" is functioning properly, you will never need more than one stage of audio, if transformer coupling is used.

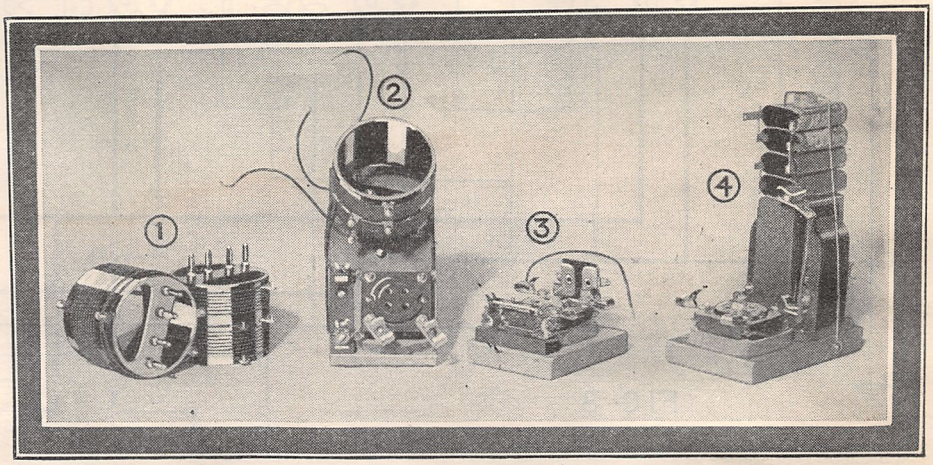
If you want real loud-speaker operation, use a UX or CX 112 tube with 130 to 150 volts on the plate and have the grid biased about 9 to 12 volts negatively. If you have a good superheterodyne and a good loud-speaker you will have volume and tone, and lots of both. If you do not get these results, investigate your receiver, because something is surely wrong. Begin an immediate diagnosis, so to speak, and get the intermediate amplifier working to its maximum without oscillation.

A word here about audio transformers, use a real one, if it costs you ten dollars. If it produces volume, tone and power, all in one stage, it's worth it. Your output will not have any better tonal quality than your transformer is capable of furnishing. Buy a transformer having a charted curve for frequencies between 100 and 5000, and choose one exhibiting a comparatively flat curve.

This or any other good superheterodyne certainly will produce sufficient useful selectivity, if properly handled and constructed. This is so well known that any further emphasis would be monotonous. However, the coupling of all the circuits must be kept *loose*. This means the oscillator pick-up loop, and the coupling in the antenna circuit especially.

Only a small antenna is needed and, of course, the smaller it is the more selective the set becomes. Nevertheless, the selectivity is only useful when tone qualities are not sacrificed to obtain it. So use discretion if you want tone.

(*In the January issue of* Radio News *this instructive article will be concluded. A large number of circuit diagrams will be shown for superheterodyne experimenting.*)



No. 1 shows the plug-in type of coil employed; 2, the oscillator unit; 3, detector unit; and 4, the A.F. transformer unit with "C" batteries.

A Universal All-Circuit Set

Building the Most Sets for the Least Money

By JOSEPH RILEY

THERE has recently been developed a kit of new type, that is especially designed for the man who wants to build his own set and experiment occasionally, without being forced to buy numerous and costly parts. It is also possible, through its use, to change from one completely built set to one of an entirely different type without redrilling the panel or sub-panel, or even dismounting most of the parts.

The receivers shown in the pictures accompanying this article have been wired, using flexible leads. It is recommended that either flexible leads or soft-drawn copper wire be used for hook-up purposes rather than bus-wire. The soft-drawn wire should either be insulated or covered with spaghetti tubing. The sub-panel furnished with the kit is drilled to accommodate all the wires if flexible leads are used; and sufficient leads are packed with the kit to wire up any of the combinations suggested.

Among the sets that can be built are: a three-tube, three-circuit regenerative receiver; a five-tube, tuned-radio-frequency receiver, with two-dial control; a short-wave receiver (19 to 535 Meters); two-tube reflex, (Crystal Detector), and a three-tube reflex (Tube Detector).

The construction of the first two will be described, and hints on their operation given, in this article.

Assuming that the builder has secured the complete set of parts listed here for the three-tube set, and that the various units are laid out on the table ready for assembly, we shall explain the first step. The illustrations, (Figs. 1, 2, and 3) show clearly the arrangement of the parts, both on the panel and sub-panel. The holes for sockets in the sub-panel are "skeleton punched" so that those not needed may be left filled, yet easily opened, when needed in other sets.

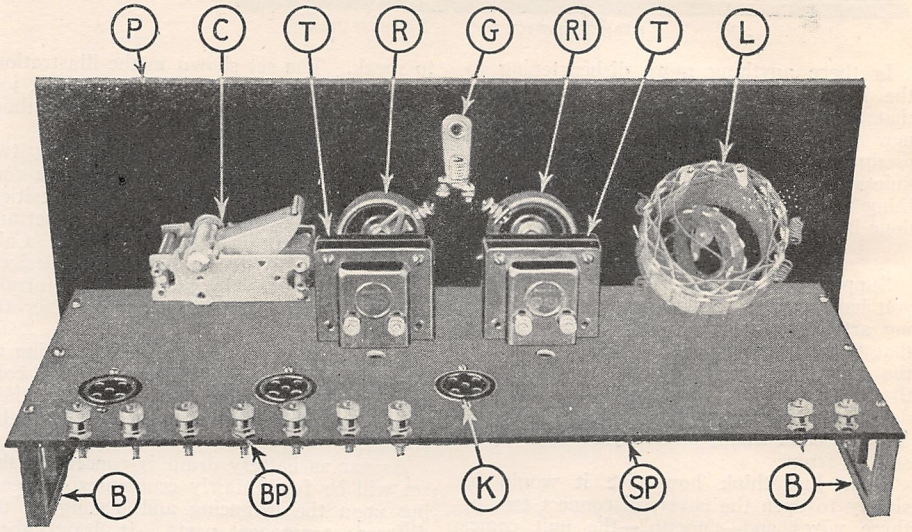


Fig. 3. A rear view of the assembled three-tube set. L is the three-circuit coupler; C the tuning condenser; T the A.F. transformer; R and R1 the filament rheostats; K the tube sockets; G the pilot light; and BP the binding posts.

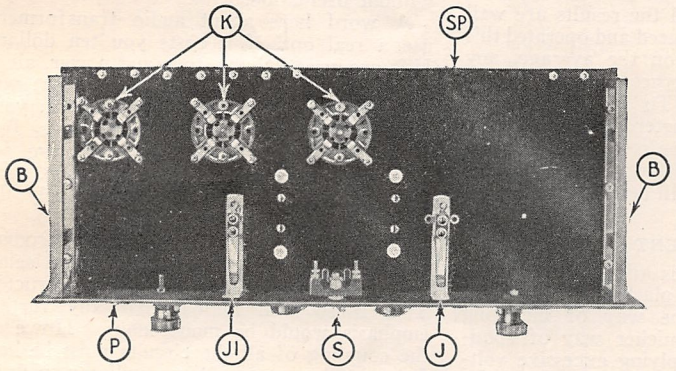


Fig. 2. An under view of the assembled three-tube set, showing the sockets K, the jacks J and J1, the filament switch S, and the supporting brackets B.

LAYOUT OF APPARATUS

It will be noticed that (looking at the panel, P, from the rear) the pilot light, G, is mounted in the exact center, and directly below it the filament switch, S. At either side, about halfway down the panel, is a rheostat, R, R1; the 20-ohm one, R1, at the right, the 10-ohm one, R, at the left, are so mounted that their terminals point toward the center of the panel. At the right side is the three-circuit tuner, L, and at the left, the variable condenser, C. The three-point jack, J, is mounted in the hole marked "First stage" and the four-point jack, J1, in the hole marked "Second stage." That takes care of the panel.

Next, the sub-panel SP. First attach the mounting brackets, B, to each end, with

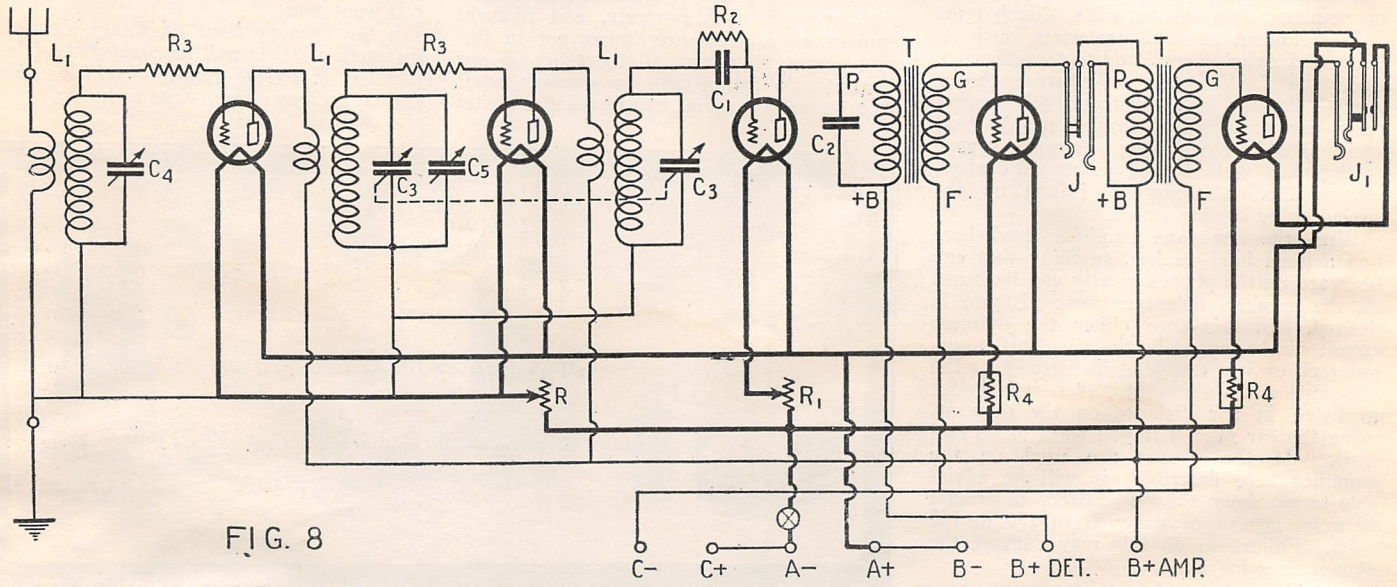


FIG. 8

The complete circuit diagram of the five-tube tuned-radio-frequency set illustrated in Figs. 5, 6 and 7. L1 are the R.F. transformers; C3 and C4, the tuning condensers; C5, the compensating condenser; and R3, the stabilizing resistances. Automatic filament controls (R4) are used in the filament circuits of the two A.F. tubes. The jack, J1, is of the filament control type.

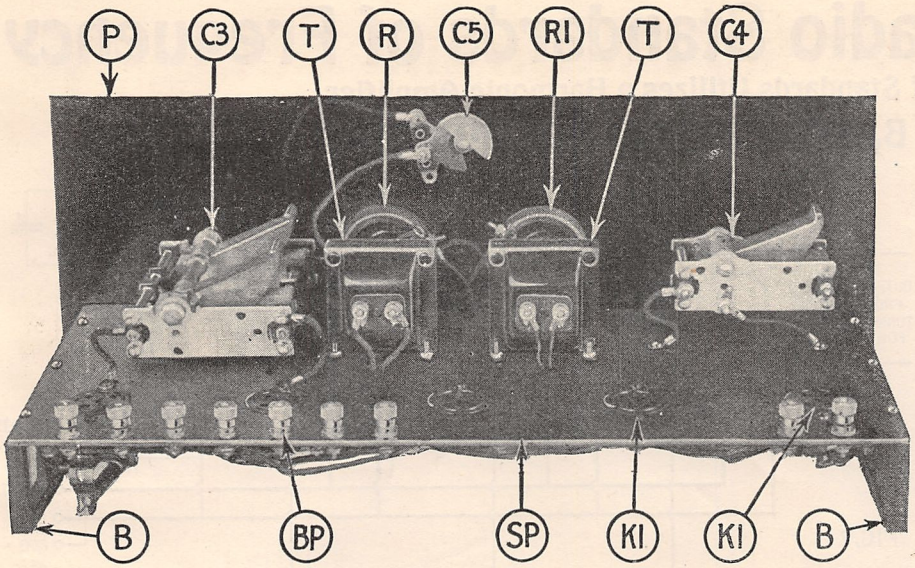
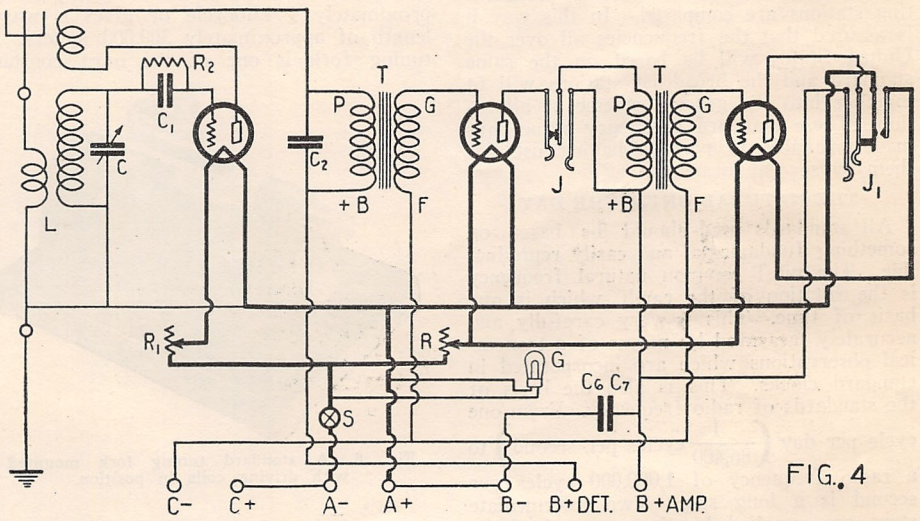


Fig. 6. A rear view of the assembled five-tube tuned-radio-frequency set. C3 and C4 are the tuning condensers; C5, the compensating condenser. The other parts are the same as those employed in the three-tube set. Note the grid condenser and leak at the left and on the underside of the sub-panel SP, K1 are the R.F. tube sockets.

the screw holes that allow them to be fastened to the panel at the proper side; that is, that opposite the binding posts. Then turn to the binding-post side of the sub-panel and, working from left to right, insert the binding posts, BP, in the following order: "B amp+"; "B Det+"; B Bat—;" A" Bat+;" "A Bat—"; "C Bat+"; "C Bat —"; Then skip over to the extreme right and put the "Ant." post in the farthest hole, and the "Gnd." post in the next one.

Just to the right of the "C Bat—" post you will find two holes spaced to take the grid condenser, C1, and the grid leak mounting clips so that the grid leak, R2, will be close and parallel to the back of the sub-panel. Next insert three sockets, K, at the left end, with their bodies and terminals below the sub-panel and their tops projecting up through the large holes. The filament prongs should be toward you, the white dots toward the panel.

Then mount one of the audio transformers, T, slightly to the right of the center of the sub-panel, and toward the side nearest the panel. The secondary of this transformer should be toward the right. The other transformer is mounted a little to the left of—best, at right angles to—the first. Its secondary will be toward you. The .002-mf. condenser, C2, is connected across the primary of the first A.F. transformer; the .006-mf. condenser and the two extra sockets are not needed in this set.



The circuit diagram of the three-tube set illustrated in Figs. 1, 2 and 3. This is of the regenerative type, using a tickler coil. The primary coil of the coupler L is aperiodic. Note the by-pass condenser, C6 or C7.

WIRING SUGGESTIONS

The wiring need not be explained in detail, as it can be readily followed from the schematic diagram (Fig. 4). The points to watch are: Connect the rotor plates of the variable condenser to the filament side of the tuning coil secondary and to the "A Bat+" terminal; use the 20-ohm rheostat to control the filament voltage of the detector, the 10-ohm one to control the two amplifier tubes.

The three-point jack, J, is connected in the output of the first audio stage, and the filament-control jack, J1, is so arranged that it controls only the filament of the last tube, turning it off when the speaker or phones are being used on one stage only. The pilot lamp, G, is wired across the two main filament leads, so that it lights whenever the filament switch, S, is on.

OPERATION

In operating this set, care should be taken to prevent the detector tube from oscillating. If it is allowed to squeal and whistle, not only will it consume more "B" current and ruin your enjoyment, but it will ruin your neighbor's reception as well.

About 75 feet of aerial will give best results. If 201-A type tubes are employed a 6-volt storage "A" battery, a 90-volt "B" battery and a 4½-volt "C" battery should be used. The detector "B" voltage may be found by trial and will be between 16 and 45 volts.

THE FIVE-TUBE RECEIVER

Instead of the three-circuit tuner, L, and the .0005-mf. variable condenser, C, this set requires the purchase of a set of three tuned-radio-frequency transformers, L1, (see Fig. 6) one two-gang variable condenser, C3, made up of two .00038-mf. (17-plate)

(*Continued on page* 682)

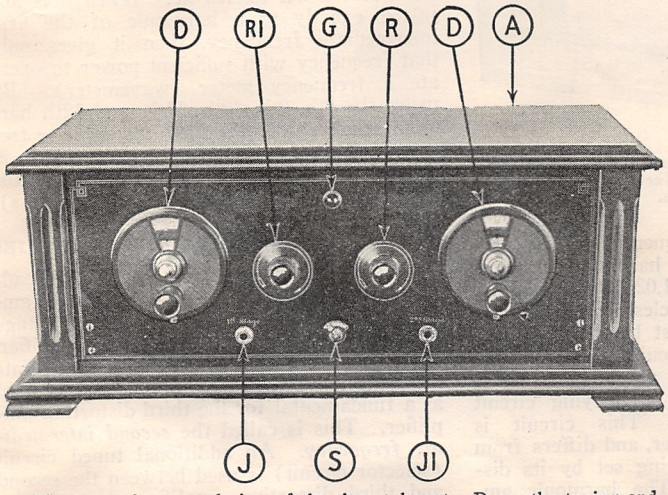


Fig. 1. A front-panel view of the three-tube set. D are the tuning and regeneration controls; R and R1, the filament rheostats; G, the pilot light; S, the filament switch, and J and J1 the audio-stage jacks.

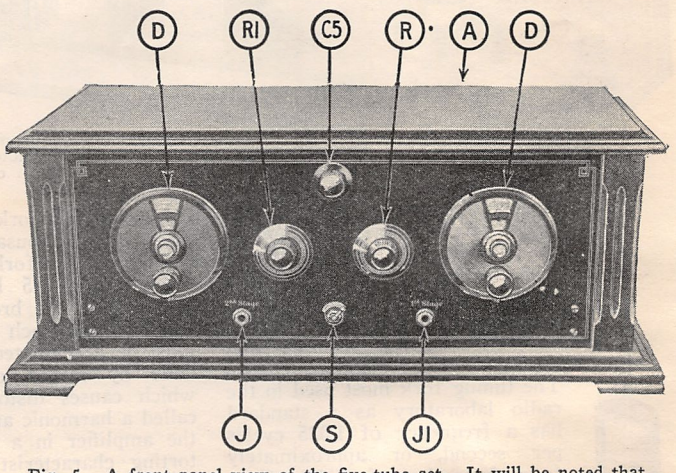


Fig. 5. A front panel view of the five-tube set. It will be noted that there is no pilot light; this position is occupied by the compensating-condenser control, C-5.

Establishing Radio Standards of Frequency

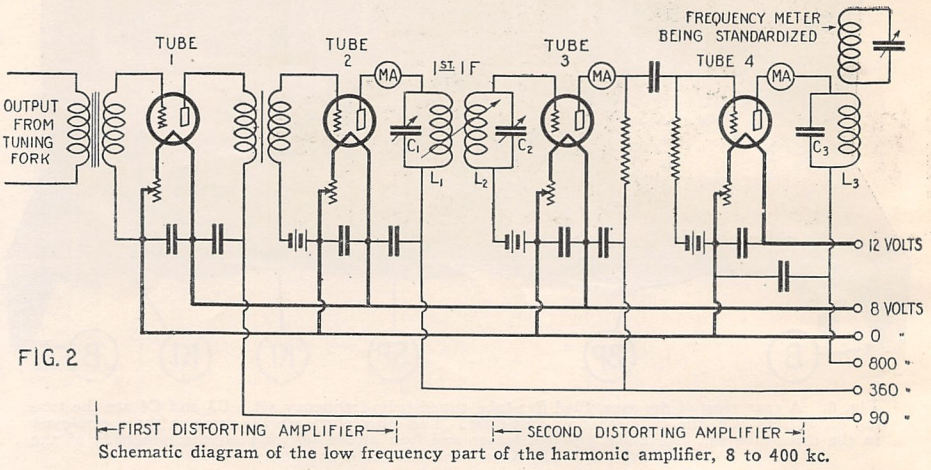
Bureau of Standards Utilizes a Harmonic Amplifier

By C. B. JOLLIFFE and GRACE HAZEN*

AT the present time radio broadcast stations are assigned frequencies (wavelengths) between 550 and 1500 kc. (545 to 200 meters), with a separation of 10 kc. between stations. This means that, if a station is not adjusted exactly on its assigned frequency, it may cause whistling interference, so that neither it nor its neighboring station (in frequency) can be heard. The larger stations take very great care to keep their frequencies correct. They use instruments to check or control them, such as frequency indicators and piezoelectric crystals. These devices, however, would be of little use unless they were adjusted according to the same standard of frequency. The Bureau of Standards maintains the fundamental standards of radio frequency with which the frequency meters (wavemeters) and other frequency measuring devices of the various laboratories, radio supervisors, broadcasting stations, and other transmitting stations are compared. In this way it is assured that the frequencies all over the United States will be based on the same standard and the broadcast stations will fit together into the general scheme of allocation. These standard frequency values are made available to persons having use for them by several means.

THE NATURAL UNIT—THE DAY

All standards used should be based on something fundamental and easily reproducible. The most common natural frequency is the rotation of the earth, which is our basis of time. This is very carefully and accurately measured by means of astronomical observations which are incorporated in standard clocks. This is also the basis of the standards of radio frequency. From one cycle per day $\left(\frac{1}{86{,}400} \text{ cycles per second}\right)$ to a radio frequency of 1,000,000 cycles per second is a long step. Two intermediate steps are supplied by the standard clocks and the tuning fork, the mechanical vibration of which can be used to produce an alternating current of exactly the same frequency as that of the fork. To determine the frequency of this current, it is made to operate an oscillograph, which photographs the vibrations by means of a moving film. On the same film are marked accurate intervals of time, by means of a clock. By counting the number of vibrations in an interval of time the frequency of the vibrations is at once obtained. The clock used to mark the intervals of time is very accurate and checked against standard clocks. The tuning fork most used in the radio laboratory as a standard has a frequency of 1,025 cycles per second, or approximately four times that of middle C in the musical scale. This means, in radio terms, that it has a frequency of approximately 1 kilocycle or gives a wavelength of approximately 300,000 meters. A tuning fork is one of the most constant timing devices known; but its frequency changes with temperature and amplitude of vibration, so that these must be kept very nearly constant and a correction made for any change which takes place.



Schematic diagram of the low frequency part of the harmonic amplifier, 8 to 400 kc.

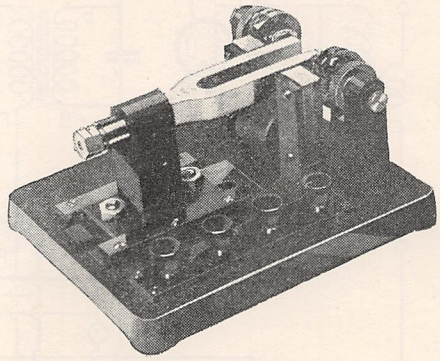


Fig. 6. A standard tuning fork mounted with driving coils in position.

By distorting the alternating current produced by the tuning fork all the multiples of the tuning fork frequency can be produced. The thousandth harmonic, for example, of this fork is 1,025,000 cycles per second, or 1,025 kilocycles (292 meters), which is in the broadcast band. The harmonics from such a circuit are weak and must be accentuated and amplified. This is done by means of an amplifying circuit which causes distortion. This circuit is called a harmonic amplifier, and differs from the amplifier in a receiving set by its distorting characteristics. The harmonic amplifier produces harmonics, selects the ones desired, amplifies them, and suppresses all others. It is so constructed that it can be used to produce at the output any harmonic of the 1025-cycle fork from the 8th to the 4000th.

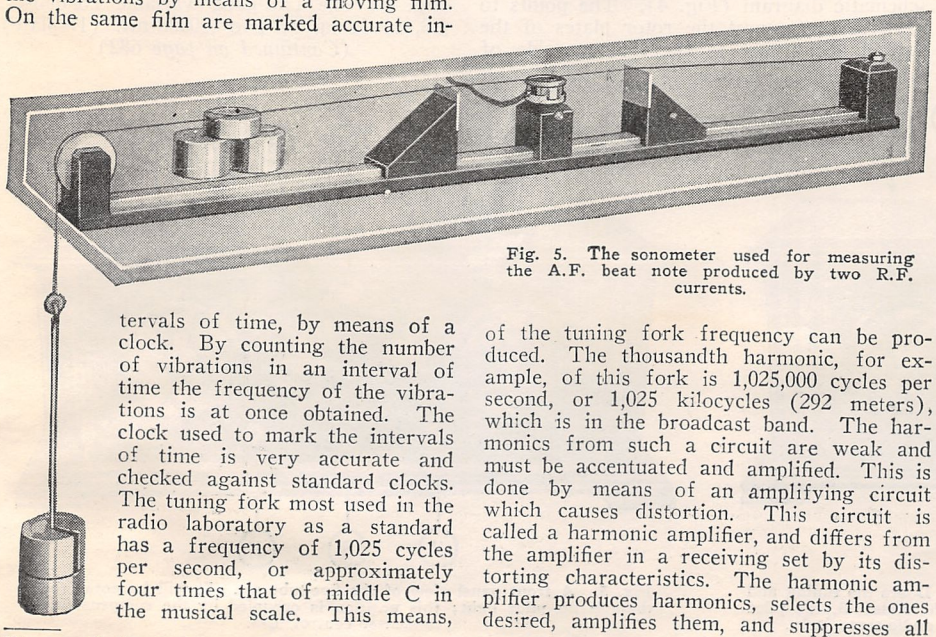


Fig. 5. The sonometer used for measuring the A.F. beat note produced by two R.F. currents.

STEPPING UP THE FREQUENCY

Fig. 1 shows diagrammatically how a desired frequency is obtained. For purposes of explanation in the rest of the paper it will be assumed that a 1000-cycle (1 kc.) tuning fork is used instead of the 1025-cycle fork. The output from the tuning fork is fed into the first distorting amplifier, which at the same time, suppresses most of the 1,000-cycle current, and produces and amplifies its harmonics. This amplifier consists of two stages. By means of tuning the two circuits (1st I.F.) one of the harmonics is selected and all the rest are suppressed. This is like tuning in a single station on a receiving set and suppressing all others that are operating at the same time. This harmonic, which is called the *first intermediate frequency*, then becomes the *fundamental* for the second distorting amplifier, which has likewise two stages, the second being a 50-watt transmitting tube. In the output of this tube there are only the *multiples* or harmonics of the first intermediate frequency.

If the frequency desired is a relatively low frequency (between 8 kc. and 400 kc.) it can be obtained directly from the output circuit of the second distorting amplifier. The tuned circuit is adjustable to frequencies from 8 kc. to 400 kc. When it is adjusted exactly to a harmonic of the first intermediate frequency, then it gives only that frequency with sufficient power to operate a frequency meter (wavemeter). By using the 8th, 9th, 10th, 11th, and 12th harmonics in turn for the first intermediate frequency, different series may be obtained in this range. The limit of this part of the harmonic amplifier is 400 kc. (750 meters).

GENERATING BROADCAST FREQUENCIES

This, however, does not reach the broadcast range. To do this a third distorting amplifier is used. A frequency in the range produced by the second distorting amplifier, that is, a harmonic of the first intermediate frequency, is selected by tuning and is used as a fundamental for the third distorting amplifier. This is called the *second intermediate frequency*. An additional tuned circuit (selector circuit) is used between the second and third distorting amplifiers in order to filter out undesired harmonics; that is, it increases the selectivity of this part of the set.

*Bureau of Standards.

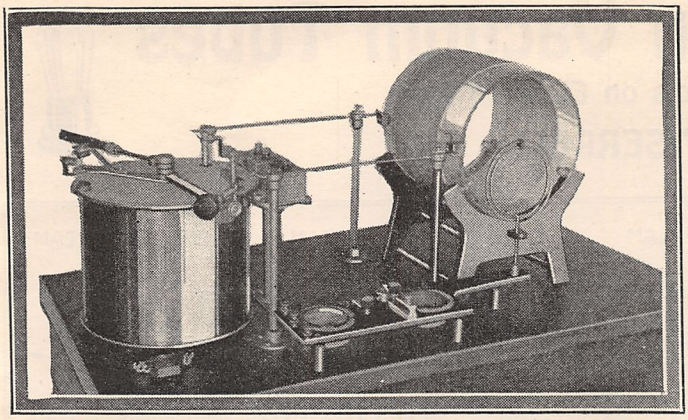


Fig. 4.
The problem of standardization in respect to radio is an old one, relatively speaking. Wave-meters are the instruments used in the determination of the frequency of a radio wave. At the right is shown one of the standard inductances used at the Bureau of Standards.

Harmonics of the second intermediate frequency are produced and amplified by the third distorting amplifier. They are then selected by the tuned circuit in the output of the third distorting amplifier. They have sufficient power to operate a frequency meter. By this tuned circuit multiples of the second intermediate frequency may be obtained. By choosing different harmonics for the first and second intermediate frequencies, from 400 kc. to 4,000 kc. may be obtained in the output of the third distorting amplifier.

When using the harmonic amplifier in this way, it is necessary to have some guide in determining what harmonics are being obtained. This is accomplished by a preliminary approximate calibration of all the tuned circuits. The tuned circuits are calibrated either by direct comparison with known standards or by calculation from formulae.

DETAILS OF THE AMPLIFIER

Figs. 2 and 3 give the detailed circuit diagram of the complete harmonic amplifier. Tubes 1, 2, 3 and 5 are 5-watt transmitting tubes and tubes 4 and 6, the output tubes in the second and third distorting amplifiers, are 50-watt transmitting tubes. Distortion is produced by means of large negative grid ("C") voltages. These voltages are sufficiently large to reduce the plate current nearly to zero when no power is being supplied by the tuning fork. This part of the grid voltage-plate current characteristic is curved and is suitable for producing harmonics. The circuits in the harmonic amplifier are so adjusted and controlled that none of them can go into self-generation ("oscillate"). For this reason the only alternating current that it is possible to have present in any part has a frequency which is either that of the tuning fork or an exact multiple of it. The harmonic amplifier then introduces no error. A poor adjustment of the circuits only results in a lowering of the output and not a change in frequency.

This apparatus will give frequencies that are very accurately known, but cannot give all frequencies, only multiples of the tuning fork frequency. It is therefore not convenient to use in general calibration work and is best adapted to calibrate very carefully constructed continuously-variable frequency meters (wavemeters) and other types of convenient frequency standards, which are in turn used as laboratory standards. Fig. 4 is an illustration of one of the standard frequency meters of the Bureau. It consists of a very carefully constructed variable air condenser and coil in series. When the circuit is coupled to a source of radio frequency, current will flow in this circuit and at resonance the maximum current will flow. The point of maximum current is determined by means of a "pickup" coil (two turns) in series with a crystal detector and sensitive galvanometer. The frequency meter circuit is tuned to resonance to an alternating current of any given frequency by adjusting the capacity of the condenser until the galvanometer reads maximum current.

The coil of the frequency meter can be changed and fixed mica condensers can be put in parallel with the variable condenser, so that the circuit can be tuned to any frequency over a wide portion of the radio range. The variable condenser is equipped with a slow-motion device so that the movable plates can be moved very slowly and a very precise adjustment obtained. The scale of the condenser is accurately engraved in 360 divisions. A vernier scale is provided so that the position of the index can be read to one-tenth of the smallest scale division.

Each position of the movable plates of the condenser represents a definite frequency value, and a calibration of the circuit consists in determining what values these settings represent. The frequency values for several settings distributed over the condenser scale are determined and a smooth curve drawn between condenser settings and frequency. From this curve the frequency value corresponding to any condenser setting may be obtained. Such a curve is required for each combination of coil and condenser values.

CALIBRATING A FREQUENCY METER

To illustrate how this amplifier is used to calibrate a frequency meter, take as an example one which covers the entire frequency band of the amplifier, 8 kc. to 4,000 kc. It is most convenient to start at the lowest-frequency value. For the low-frequency values only the part of the apparatus shown in Fig. 2 is used. The first point desired is 8 kc. The proper coils are inserted for L_1 L_2 and L_3, and the condensers C_1, C_2 and C_3 are set where previous calibration has shown that all the circuits would be tuned to 8 kc. The readings of the milliammeters (MA) will then show an increase in the values of the plate currents, which indicate that the alternating current is going through. The frequency meter coupled to L_3 is then adjusted until it shows a deflection. Slight readjustments are then made until the maximum current is flowing in the circuit L_3C_3. The frequency meter is then adjusted very carefully until its indicator shows exact resonance. The position of the condenser scale is then read and gives one point of the calibration. The same proceedure is then followed for the 8th, 9th, 10th, 11th, 12th, 13th, 14th and 15th harmonics of the tuning fork frequency, the second distorting amplifier acting in these cases only as an amplifier.

(*Continued on page* 706)

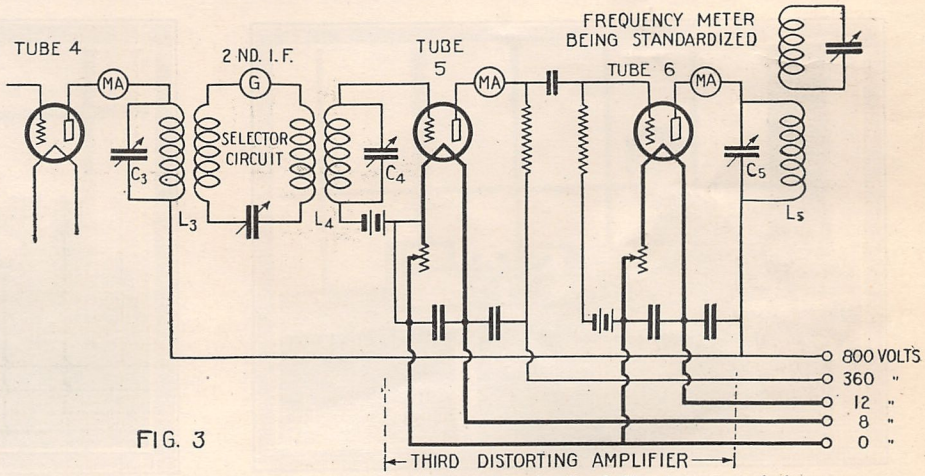


FIG. 3

This is a schematic diagram of the unit added to the circuit of Fig. 2 to extend the range to 4000 kc.

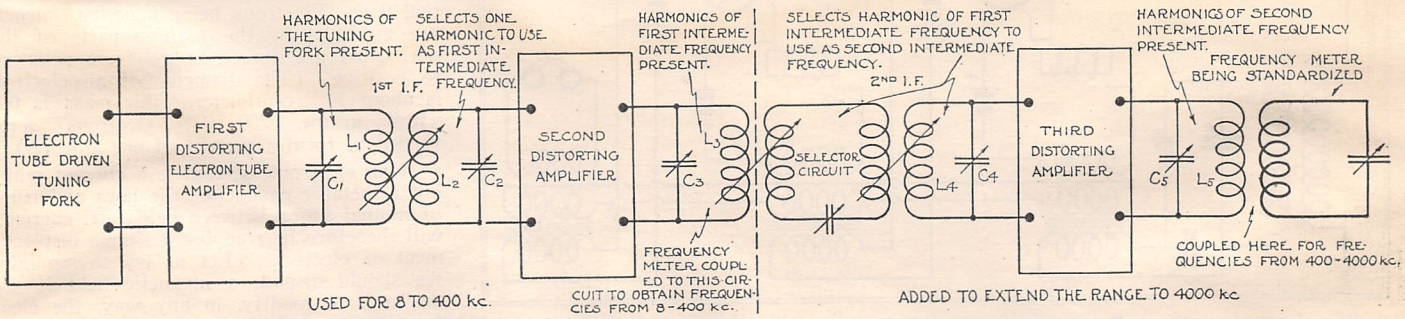


Fig. 1. This diagram shows how frequency values are obtained by means of the harmonic amplifier.

Magnetic Fields in Vacuum Tubes

A Study of Field Effects on Electron Flow

By ROBERT SERRELL

IT is a very frequent occurrence to read in articles on radio-receiver construction, that no coil and no air- or iron-core transformers should come near the tubes, especially the detector, if you do not wish them to become "silent." Radio designers often tell you that any magnetic or electrostatic field can perturb the electronic emission from a vacuum-tube filament; and that parts of the set creating such fields (condensers, coils, etc.), must not be in proximity to any of the tubes.

On the other hand, many amateur experimenters have experienced an increase in the intensity of received signals, when the poles of a powerful magnet were disposed in a certain relation to the detector tube.

Is it really important to separate tubes from field-producing parts? Can the use of a magnet really produce better reception? The writer has conducted several experiments to determine these facts.

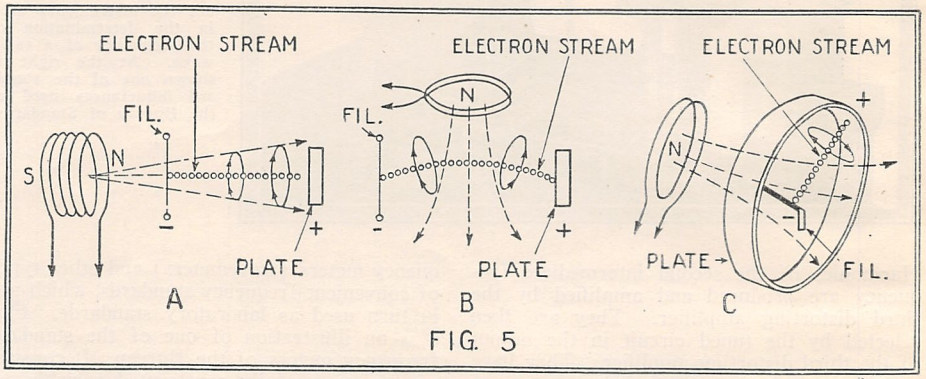


FIG. 5

Showing the three possible positions of a magnetic field in relation to the electron stream in a vacuum tube. The general tendency, when the magnetic field is positioned correctly, is toward a curving of the electron stream in its trajectory, and consequently lessening of the flow of plate current.

EARLY EXPERIMENTS

It is interesting to note that magnetic fields were used long ago in connection with vacuum tubes. De Forest seems to be the first to observe the effect of such fields upon the amount of current passed by thermionic tubes.

He invented and patented, among many others, the circuits shown in Fig. 1. (See RADIO NEWS for Nov., 1922, Page 896, "The Radio-Patent Situation.")

The well-known French amateur, Pierre Louis (F8BF) gives in his book *"La T. S. F. par les Tubes à vide,"* the circuit shown in Fig. 2, which he invented. An electromagnet, connected in series with the high-voltage filament of a two-electrode tube and with the secondary of a special transformer carrying detected currents, was supposed to produce audio-frequency amplification of received signals.

In fact, however, these old tubes did not work very satisfactorily. It was never possible to make any magnetic arrangement in connection with two-electrode tubes, giving the good results of the small electrostatic field introduced by the grid of our modern tubes.

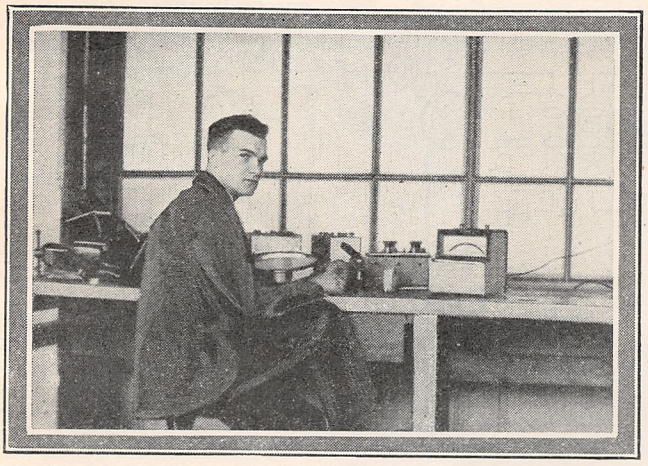
One of the reasons is probably that these magnetic fields were not impressed in the correct way upon the electronic streams of the tubes. Odd to remark, this arrangement seems to be the only one in which the effect is theoretically zero.

This is easy to prove and explain: It is a well-known fact that an "electronic stream" can be considered as a current. It has been proved that a current is nothing more than a displacement, from the negative to the positive, of the electrons contained in every conductor.

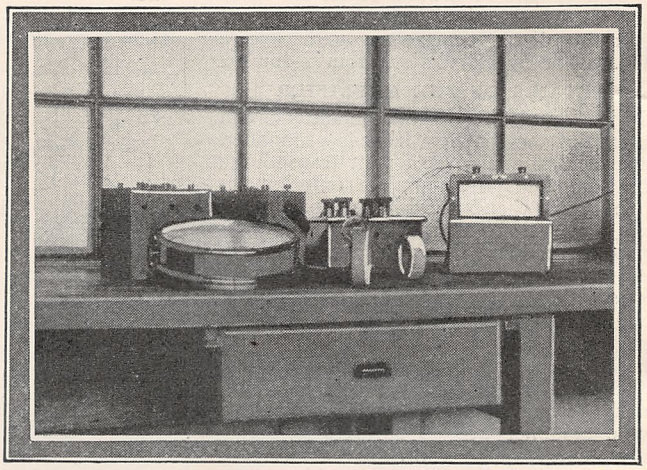
It is to be noted here that the conventional direction of the current, from positive to negative, as shown, is reversed from the actual flow. Electrons, being *negative charges*, are attracted by the *positive* parts of the wire; and are forced to go from negative to positive. (The diameter of an electron is about 10^{-13} centimeters; this mass is 0.8×10^{-27} grams. 700×10^{16} electrons are needed to form a current of one ampere.)

If an electronic stream is a current without a metallic conductor, the laws and rules of mutual action between fields and currents will therefore be true for a simple displacement of electrons. Let us try to see how we should dispose a magnetic field if we desire it to modify, in any way, the electronic stream of a vacuum tube.

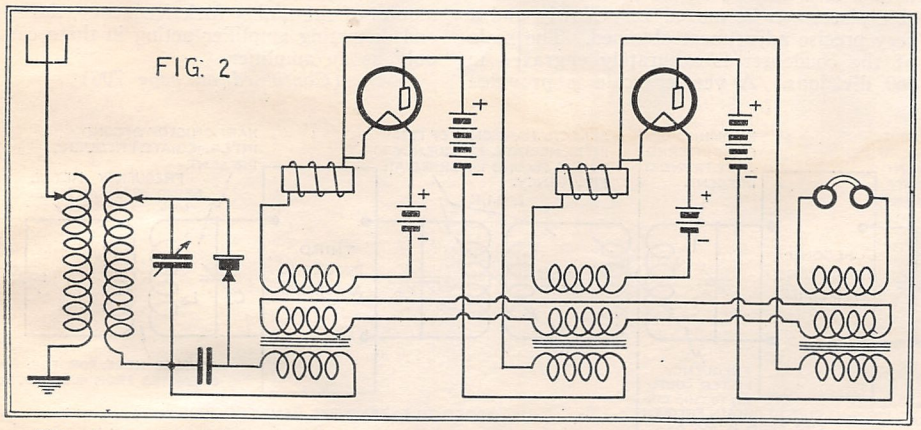
(*Continued on page* 728)



Mr. Serrell in his laboratory in Paris, France, where he carried out experiments on the effects of magnetic fields and vacuum tubes, the results of which are published in this article.



A closer view of the laboratory apparatus employed by Mr. Serrell in his experiments on the effects of magnetic fields upon the action of vacuum tubes.



This circuit, devised by a French amateur, uses in the filament circuits electromagnets intended to affect the flow of electrons to the plate, and thus produce A.F.-signal amplification.

"Design Engineering" In Radio Apparatus

On the Importance of "Straight-Line-Sequence" Construction

By EDMUND T. FLEWELLING

THE writer proposes in subsequent articles to show the design, or "how to build," of a seven-tube superheterodyne, a three-tube simplified receiver, and a receiver based on double-grid tubes. These receivers will be in answer to numerous inquiries, and are intended to simplify greatly set construction and to remove all uncertainty as to results. Before taking up the individual data for these receivers, however, it will be best to go into fundamentals of the design of these receivers; for "design" goes far beyond hook-up, or "what kind of coils have you?"

The design of radio receivers should by all means include within its scope the mechanical layout of the parts to be used. The best design will be that which most fully recognizes the fact that the electrical and mechanical features of a receiver have many things in common, and will work together to produce the best results.

CAUSE OF FAILURES

Hook-ups are important; low loss is important in its place; confined-field coils, (toroids, binoculars, etc.) are important; neutralizing and feed-backs are important. But combine all of the best of these and yet your receiver will be a "howling failure," if you neglect or do not recognize the fundamentals of combining the mechanical and electrical features to best advantage.

If the author be accused of attempting to inaugurate a new craze in the "mechanics of receiver design" he will be honored; for lack of knowledge on this point has been the reason for most of the failures on the part of the amateur to build his own. Had proper attention been paid to the many instructive articles on how to build the popular receivers, thousand upon thousands would still enjoy building, instead of just listening. I have seen many cases of home-built "Flewelling Circuits" that almost brought tears to my eyes, because I could not recognize my own child.

Lest there be a feeling that the design that we are to consider be the opinion of only one individual, let me hasten to say that it has been the subject of conference with about a hundred radio engineers; among them being some of the leading figures in the art. We can be sure then, that basically our design will offer a substantial gain over any thing yet described along this line.

EACH PART HAS ITS PLACE

In the first place every engineer recognizes that each part of a receiver has a definite location; if this location be changed (mechanically) then it must be compensated for electrically.

Any "How to Build" article (in my own humble opinion) is not worthy of the name if it does not either take up this matter of location, or offer a design that does take it up automatically. It is proposed that our receiver articles be written in the latter fashion. That is, we shall specify certain parts, and design the receiver in such a way that all spacing and locations will be taken care of automatically. It is believed that this will make it possible for a fan in South Africa to build an exact duplicate of the receiver as built by the designer and be sure of the same results.

Fig. 1 shows the bottom and Fig. 2 the top of the sub-panel in a six-tube receiver of such design. Note that this receiver is completely built and in operating condition, and that the only wire used is that shown in Fig. 2, connecting the stators of the condensers to the grids.

About four inches of wire is used in this receiver and, while those to be described may contain a bit more, they will line up about as shown in Figs. 1 and 2.

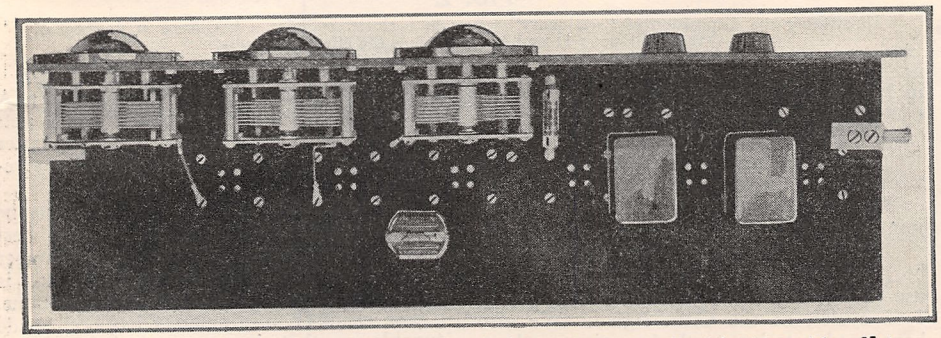


Fig. 2. The top view of a special T.R.F. set embodying the ideas outlined in this article. Note the simplicity of layout and particularly the absence of wires.

The fact that a receiver does not contain much wire is not the answer to the problem of design. Common sense is much better. You remember when we connected the detector-grid condenser to the tube socket by at least six inches of wire? Common sense finally coaxed us to mount the grid condenser directly on the grid post of the socket. Why bother to run a wire to a coil terminal if the coil terminal also could be mounted upon the socket terminal?

Yet, while we could go through the entire receiver asking such foolish questions, we would accomplish only elimination of wires; that is, a mechanical improvement, and very little electrical improvement or combining of the two.

SPECIAL CONNECTORS

All battery leads ("A-B-C" etc.) are common to the receiver throughout its length. All receiver design emphasizes the need for by-passing these battery leads. If we make each lead in the form of a wide brass strip, extending along the receiver, and then pack all of these strips together with an insulator between each pair, every lead will have a large capacity effect upon its neighbor. We will have all battery leads common to the receiver, each lead acting as a condenser plate, and all leads properly by-passed for radio frequency.

Such a construction may be seen in Fig. 1, in the flat strip running the length of the panel. Taps or tabs are brought out from each battery lead, and the length and location of these tabs determine the exact spacing of the stages throughout the receiver. The details of the strip are shown in RADIO NEWS for August, page 141.

There are on every automobile of accepted design, four wheels, a chassis and a body. All designers accept the needs of these things, place them in the same relative position in their design and yet find room for all kinds of individual expression in the completed job. Radio needs exactly the same recognition of some of its fundamentals.

SHORTEST-LINE CONSTRUCTION

All receivers use tubes, transformers and condensers. All hook-ups start at the grid of a tube and end at a plate. Some radio engineers build receivers with the body under the wheels and the chassis alongside of them; while others conform to the logical sequence of things they build—into the grid, out of the plate into the next grid, etc.—and waste no time doing it.

Study any hook-up and you will find that its best expression in a receiver follows the hook-up in a straight-line sequence, in and out by the shortest possible means. If every receiver were adapted to this scheme of things, radio designers would begin to reap the benefits in the same manner that automotive engineers and other kindred professions are doing. Reduce anything to definite fundamental form, accept this as a fact; and then, with such a solid foundation to work from, all kinds of experimentation and individuality are made possible.

Present-day radio practice does not accept any such foundation to begin with, hence any change, anywhere, cannot begin to express its own undivided effect upon the completed structure. To accept a delicately-assembled receiver, wired together as best as may be,

(*Continued on page 722*)

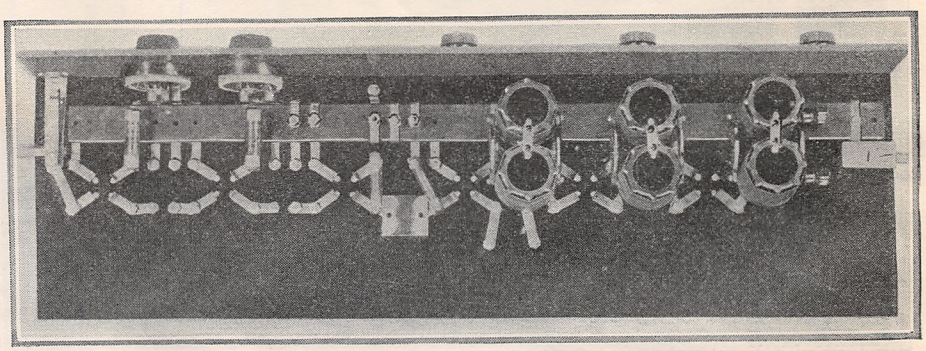


Fig. 1. The under view of the set shown above; again, note the absence of wires. Practically all leads are continuations of the tube-socket contact strips.

The Acoustat

A Practical Static Reducer for C. W. Telegraph Receivers

By O. C. ROOS

THERE is a simple piece of apparatus knocking at the experimenter's door today. It reduces static for C.W. telegraph work and has been tested out by engineers prominent in the technical radio world. Through greater general interest in radio broadcast reception, it has not however been brought forward as a solution of DX static troubles. A new type is expected to cover broadcast reception by purely electrical means, whereas this apparatus is purely acoustic. The name "Acoustat" has been given to it and as the parts are cheap and can be made at home by any fan, it may be a source of pleasure to the radio telegrapher to experiment with it.

WHAT THE ACOUSTAT IS

The Acoustat depends on a new application of an old fact. When several youngsters "holler" into a rain barrel the same hollow ring comes back from each shout. In other words, the air in the barrel is shock-excited and gives back principally its own natural frequency of vibration—no matter what kind of irregular acoustic shock is given to it.

In 1911 in the Philippine Islands through experimenting with bamboo tubes to imitate the Braun system of audio resonant selection of spark signals—the idea of the "Acoustat" was born. Turn a noise into a predetermined musical tone.

That "predetermined" part is of great importance. If you had a message by 1,000-cycle heterodyne rectifier beats, you could change your "static" noise to a 666-cycle note or something which would not resonate to 1,000 cycles to an appreciable extent.

This was done by putting the diaphragm of the receiving phone at a short distance from a semi-open chamber and letting the "static" cause the phone to "holler" into this "near-rainbarrel." The result was a hollow "boom," which was readily proven to consist mostly of the natural lowest vibration of the "rain-barrel."

IMPORTANCE OF THE ECHO-CHAMBER

This rain-barrel in one arrangement gives out 910 cycles, or double vibrations, per second. The signal beat-tone, which is used therewith, can be 3/2, 5/2, 7/2, etc., of the above 910 cycles. A frequency of 1365 cycles worked very well.

It is obvious that we can listen to a signal of 1365, 2275, 3185 and 4095 cycles, when passed through the rain-barrel as in Fig. 2. We had the following situation in the early stages of "Acoustat" research. The phone, 1, in Fig. 1, which gives out a highly damped click, has a distinct predetermined period. Theoretically it has several, but these upper frequencies are not appreciable in the free vibration of the diaphragm after a "click" or "grinder" has almost pulled it out of joint and then released it.

At the same time an audible note may be given out by the diaphragm due to the use of a "ticker" for partial interruption at 1365 cycles, of the C.W. signal. We also have used rotating toothed-vernier condensers to detune the signal at 1365 and higher frequencies.

These precautions were only subsequently found to be necessary, but are mentioned here, as some "wiseacres" have decided that the "Acoustat" cannot be used on ultra-short waves. It is true that the heterodyne can not be used with much success in the "Acoustat" at frequencies above 1000 Kc. The above ticker or preferably modulated C.W. signals—is the perfect remedy for that drawback.

EARLY HOOK-UP TUNING

Coming back to Fig. 1, we find an air pulse from phone 1 striking the echo chamber wall, 3, via the opening, 2. The distance between 1 and 2 was a cut-and-try matter. A 1365 cycle note goes through 2 and gets through 3 as well as it can; since the latter is not sharply tuned to any particular frequency.

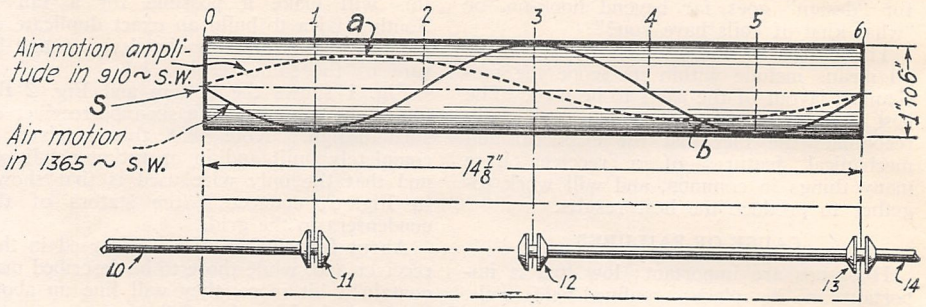


FIG. 2

Illustrating the disposition of "stationary" waves in a closed cylinder. A change in position of the "pick-ups" 11 and 12 determines the effective results.

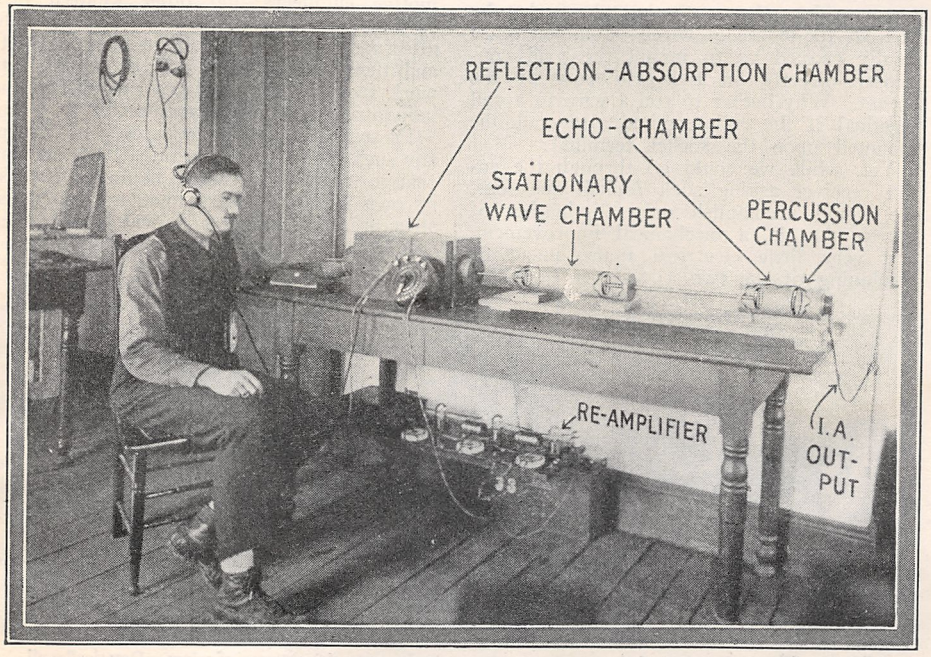
The adjustable mouth-piece (2) can be moved in-and-out axially to get the best sound development in the echo-chamber when static "clicks" the phone 1, but that is as near to tuning as this arrangement came.

The chamber, 3, ultimately has been made tunable so that it passes perfectly upper frequencies like 4095 cycles, etc., as well as generating a fundamental "echo-tone" of 910 cycles, but that was a later development. The double tube, 5-6, with mouth, 4, fastened to the echo-chamber, 3, has a stethoscope rubber tube, 8-9, fastened to it at the outer end, 7.

By sliding 6 back and forth in 7 the signal tone was tuned in and was generally found to be about half as loud as the static "boom," which gets into the listening tubes. Considering that it was only about ⅛ the strength of the static audibility, the signal-static ratio showed an encouraging increase, even in the above crude arrangement.

It was soon found, however, that it would be a vast improvement to convert both the 1000-cycle signal note and the 666-cycle note into stationary sound waves in closed cylindrical tubes, which were in acoustic resonance to both of them. One could then explore the inside of the cylinder by a small tube with a stethoscope attachment for stationary sound waves.

We now had a series of loud spots for two different sounds discovered, as in Fig. 2; so that a thousand-cycle S.W. (stationary wave) would show a maximum of sound every 6¾ inches, which is ½ the wave length. The ends of the closed tube would be maxima of sound for all frequencies, but in a 20¼-inch tube there would be a place in the middle where the 1000-cycle note was a maximum for picking-up purposes while the 666-note was very weak. Such are the properties of stationary acoustic waves.



A view of an Acoustat in operation at Rockland, Maine, picking up static-free signals from POZ, Nauen, Germany. The important parts of the device are shown in detail.

"SPATIALIZER" SOLVES PROBLEM

If the shape of the percussion-chamber is carefully determined, the net result of a sharp air pulse will be approximately a single frequency excited in the echo-chamber or—as it is often called—the reverberator, 3 of Fig. 1. Waiving the question of tuning 3 to the signal tone, we now pass both the "echo-tone" from 3 and the signal tone itself into the stationary wave chamber, 5, which is often called a "spatializer." Both the above tones, say of 910 and 1365 cycles, are tuned, when they reach 5, into stationary sound waves, distributed in space along the axis of the spatializer. If the left hand end of the tube, 6, in Fig. 1 is passed through a hole in the end wall of 5, axially into the "spatializer," a series of maxima and minima will be noted at equal intervals for 910 cycles and an entirely different set of intervals will give a separate set of maxima and minima for 1365 cycles.

To be more precise; a tube of 13.5 inches gives a complete stationary wave for 1000 cycles, if the sound is introduced at 3⅞ inches from either end. Now in a 14⅝-inch tube we will have a complete stationary fundamental wavelength for 910 cycles and one and a half stationary waves for 1365 cycles.

EXPLANATION OF "STATIONARY WAVE"

So many experimenters are ignorant of the meaning of a "stationary wave" (S.W.) that we will dwell a little on Fig. 2 in order to explain how it is formed and some of its properties.

Imagine the tube S in Fig. 2 to represent a long cylindrical room—perhaps 12 feet high and 70 feet long, or so. If an observer had a tuning fork or a very powerful siren at point 1 on the axis giving a note having 1/10 or 1/6 of the room length as a quarter wave, there would be a stationary wave formed. This wave has the following interesting properties. At points 0 and 6 at the end walls of the chamber there would be no motion of the air. This would also be true at points 2 and 4, in spite of the fact that here there is nothing to hinder air motion.

On the other hand, at 0-2-4- and 6 there is a different form of acoustic energy present. It is potential or stored energy—the energy of compressed and rarified air, which has hardly any motion along the tube axis.

If small holes are made at points 0-2-4- and 6 in the cylindrical walls, a candle will be blown out by the rhythmic puffs at so many cycles per second. This comes from the A.F. "puffs" and "suction" of air in and out of these holes, but no such thing occurs at points 1, 3 and 5 and hence these points are not available for picking up the desired frequencies of acoustic energy and carrying it on to the next chamber in the "Acoustat."

However, the points 1, 3 and 5 are ideal for "inlet" acoustic couplings, like 12, where there is a maximum of air motion. These are points of kinetic energy—or energy of motion.

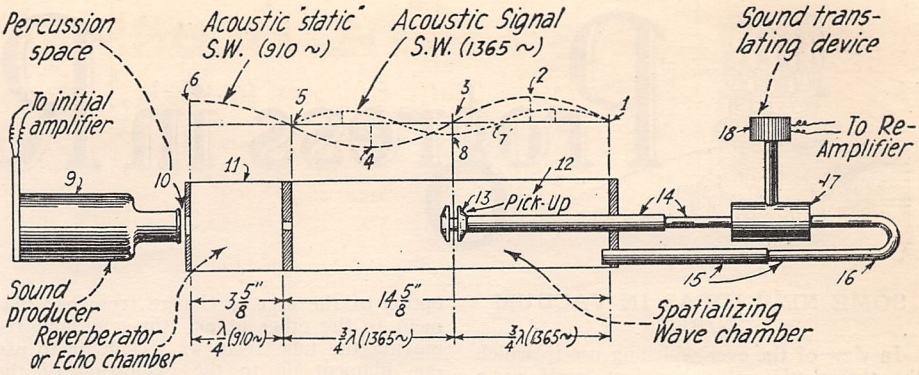


FIG. 3

Details of a small Acoustat comprising a sound producer, an echo chamber, a wave chamber, and a pick-up connected to a re-amplifier.

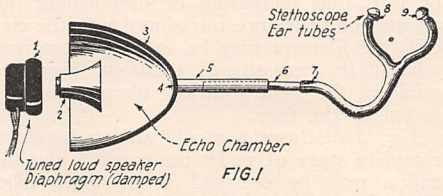


FIG. 1

A very simple form of Acoustat, serving to convey the idea of the fundamental principles of operation. The unit 2 may be an ordinary telephone mouthpiece.

CONDITIONS OF OPERATION

A little thought will show that if the end wall at 6 were removed we would have no stationary wave, which is thus always a phenomenon of reflection and resonance. In other words—a noise or acoustic "shock" in the "room" at 1-3 or 5 would not produce a stationary wave. We must have a note of at least a dozen periods in duration to give true acoustic resonance in S. This note must of course not be noticeably damped during this interval of time.

Few observers realize that, if the air had no wall friction or internal friction — we would have a true acoustic "spring and weight" here. Or rather we would have three; for the wave can be excited at any of the points 1-3-5, giving 3/2 of a complete stationary wave.

After excitation by resonance, it is theoretically conceivable that, partitions placed at 2-4 and 6 would give us three tones going on forever. We could not hear them without damping them out, but they would be there, just the same.

AIR PENDULUM

We have this difference between the "spring and weight" and a half wavelength of a stationary wave. In the ideal pendulum the weight is "lumped" or concentrated; in the air the weight is distributed.

The "spring and weight" is supposed to have its potential energy stored up in the spring, whose weight may be negligible. On the other hand, the air itself becomes the spring, when compressed or rarified. The "acoustic springs" so-to-speak are distributed.

In both cases there is sharp resonance and any number of stationary waves may be developed in a tube from one inlet point if they have the proper relative wavelengths.

As shown in Fig. 2—the 910-cycle wave has maxima of air travel at points "a" and "b" at ¼ wavelength from each end of the spatializer, S. This would be the place to put the input air coupler shown at 12 if we wanted a strong 910-cycle wave. We, however, want to get away from this "static" energy at 910 cycles and so we do nothing to help it; although the Acoustat never directly cuts down the development of static

(*Continued on page* 714)

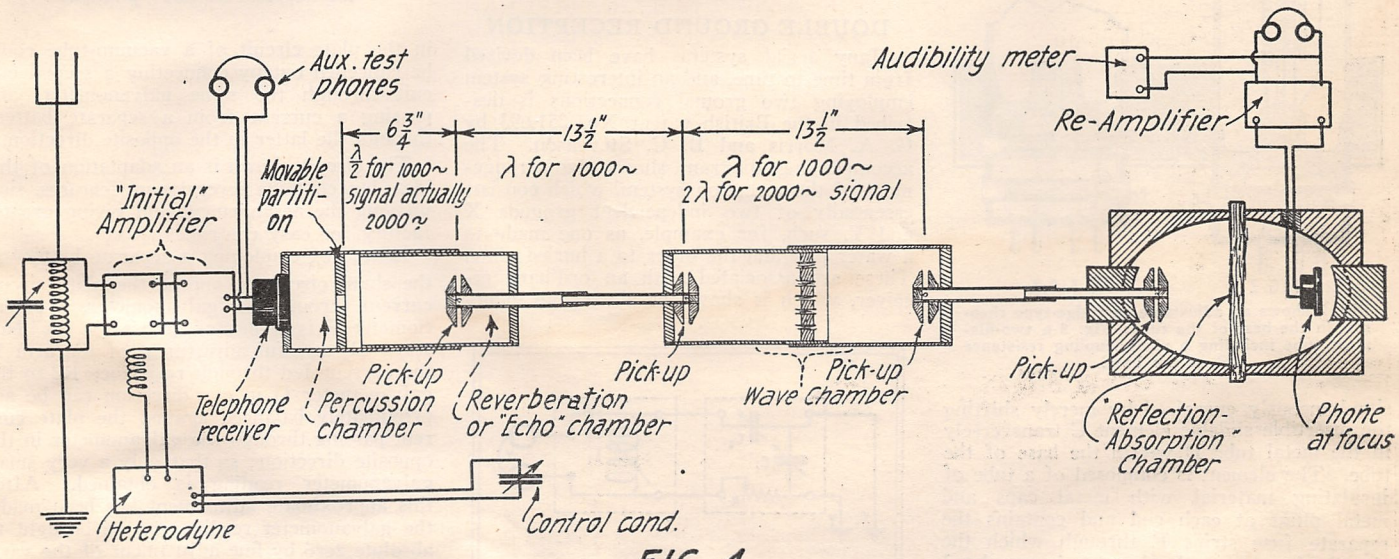
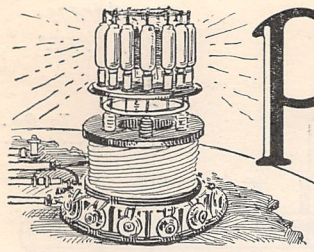
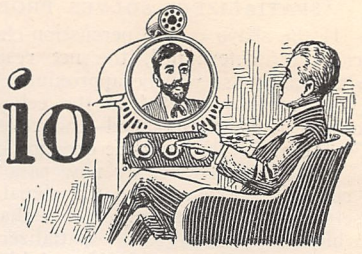


FIG. 4

The complete diagram and detailed specifications of the original Acoustat. The signals are received, heterodyned and amplified in the usual manner, fed into a loud-speaker unit and thence through the Acoustat proper. Due to a loss of signal strength a re-amplifier is employed at the output end.



Progress in Radio



SOME NEW IDEAS IN VACUUM TUBES

In view of the ever widening use to which the thermionic valve has lent itself as a detector and amplifier of electrical oscillations, improvements involving structural and functional differences in this device are of interest not only to the electrical and radio engineer but to the general public as well.

The tubes shown in the accompanying illustrations are departures from conventional

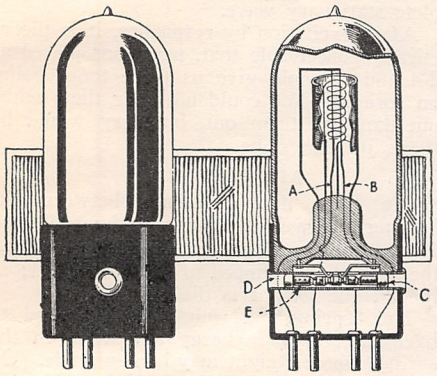


FIG. 1 FIG. 1-A

Two views of a new-type vacuum tube with two filaments, either of which can be used by adjusting the fuse plug in the body of the tube base.

designs and are the result of prolonged experiments made by Mr. Edmund G. Murphy of Philadelphia. Their dimensions and exterior appearance are such, however, as to permit their use in the standard sockets used in receiving sets.

Fig. 1 (a side elevation) and Fig. 1a (a cross section of Fig. 1) disclose a thermionic valve containing two filaments A and B, which may be separately and selectively or

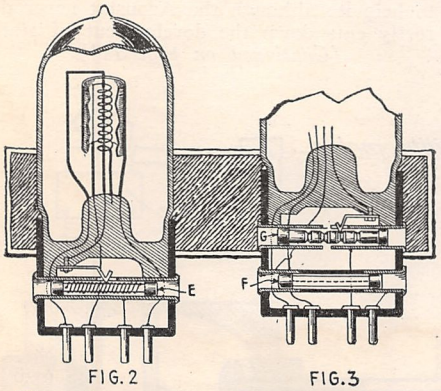


FIG. 2 FIG. 3

Fig. 2 shows an adjustable cartridge-type rheostat in the base of the tube; Fig. 3 a two-filament tube including a plate-coupling resistance F in the base.

simultaneously energized by merely shifting the insertible slidable element C transversely in the metal tube D within the base of the tube. The element is composed of a tube of insulating material with metal caps and metal plugs at each end and contains the separate fuse strips E through which the circuit of one or both filaments is completed from the filament prongs of the vacuum tube.

In the above construction, it will be at the option of the user to change from one filament to the other at any time, without removing the tube from its socket, or to use one filament up to the expiration of the natural life of this element after which the other filament may be brought into use, thus giving the tube a new lease of life. If desired, both filaments may be simultaneously energized by placing the element C in the middle. Should excessive current be applied to the filament circuit, either or both of the fuses E will be melted and the circuit broken. In this case it will be merely necessary to insert another element in order to place the tube in operative condition.

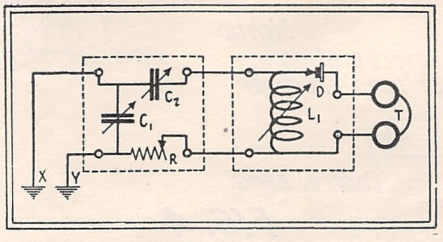
Fig. 2 is a cross section of a vacuum tube wherein a rheostat E in the form of a transversely slidable tubular element containing a filament protecting fuse is mounted in the base of the tube. By shifting it to the right or left, thus increasing or diminishing the amount of resistance introduced into the circuit, the filament may be variably energized without the necessity of additional rheostats while at the same time the filament is protected by the fuse.

Fig. 3 discloses a modification wherein a complete stage of resistance-coupled amplification may be obtained in a single tube. The plate circuit is completed through the high resistance insertible element F, which is in series with the plate while the grid circuit includes the element G which is a combined condenser and impedance—the condenser being in series with the grid and the impedance being in parallel with the grid and negative filament. The proper capacity and resistance values for this tube suitable to a given circuit may be promptly found by means of the insertible elements F and G—the appropriate values being found by substitution.

By the use of tubes of the type shown it has been found that many external control attachments and the wiring necessary for same can be eliminated. For experimental work and construction of sets also many practical conveniences result.

DOUBLE-GROUND RECEPTION

Many aerial systems have been devised from time to time, and an interesting system employing two ground connections is described in the British patent No. 251,693 by G. A. Morris and B. C. Stevenson. The accompanying diagram shows the arrangement of the reception system, which consists essentially of two independent grounds X and Y, such, for example, as one made to a water pipe and the other to a buried plate. These are associated with an ordinary receiver, which is shown as a variable induc-



A circuit used for double-ground reception. A vacuum-tube detector may be used in place of the crystal.

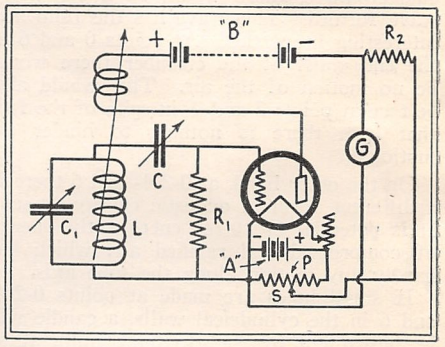
tance L_1 and a crystal detector D connected to a pair of headphones T in the normal manner. Connection from the grounds is not made direct to the set, but through an arrangement of variable condensers and a resistance.

Thus, there are two variable condensers C_1 and C_2, the former being in parallel with the two grounds and the latter in series with one ground, while the variable resistance R is in series with the other ground. The remote side of the variable condenser C_2 and the variable resistance R are connected to the ordinary aerial and ground terminals of the receiving set. The series condenser C_2 may be between 0.00001- and 0.0003-μf., while the shunt condenser may be of the order of 0.001-μf., and the variable resistance may be about 20 ohms. In another modification of the invention radio-frequency chokes are shown connected across the two variable condensers C_1 and C_2.

—*Wireless World.*

A SENSITIVE VACUUM-TUBE RELAY

In 1921 J. J. Dowling, of Dublin University, showed that the effect of a steady current passing through a galvanometer placed



A very sensitive vacuum-tube relay based on the "opposed-currents" principle.

in the plate circuit of a vacuum-tube could be cancelled out by connecting a second circuit through the same galvanometer, and passing a current from a separate battery through the latter in the opposite direction.

The circuit shown is an adaptation of this idea, but contains several new features, simplifying the arrangement and giving greater facility for easy control.

Instead of employing a separate battery in the shunt circuit to oppose the plate circuit current through the galvanometer, a potentiometer P is connected across the "A" battery. By careful adjustment of the arm S, the current fed through resistance R2 to the galvanometer G in one direction can be approximately balanced against the plate current passing through the galvanometer in the opposite direction; so that only a very small galvanometer reading is obtained. After this approximate adjustment has been made, the galvanometer reading can be brought to absolute zero by fine adjustment of the variable grid condenser C.

This circuit, no doubt, has many possible

(*Continued on page* 720)

IS RADIO AT A STANDSTILL?

Editor, RADIO NEWS:

Is radio at a standstill? (Editorial, by Hugo Gernsback, September RADIO NEWS.) I should say not! When I sit down and tune in on my new ten-tube superflex-iodyne, and then let my thoughts ramble back to about 1910, well say!

Radio has always been my pet affliction, since the good old school days. How well do I remember the first 100-foot mast I built (?) in 1912. Made of 1½-inch yellow pine, all varnished, etc., with nice, shiny aluminum wires, flag, and everything! Sure looked pretty, laying on the ground, all ready to set up. After all the available neighbors arrived to witness the ceremony, I set up a 30-foot gin pole, tied on the center of my new masterpiece, and pulled her up. The center arrived at the top, but both ends insisted on lying on the ground! Took lots of deep thought to overcome that obstacle. But true genius always wins out in the end. I sawed it in half, and made two 50-foot masts instead.

Then that soul-stirring and never-to-be-forgotten day when I went to Philly, climbed aboard an old M & M tub, and cast my awe-struck optics over the old Marconi set, and the "op." all covered with gold braid, with static embroidered on his coat sleeves! Talk about your nerve tonics! That was the most powerful stimulant I ever took, the nectar of corn not excepted. Fired with an unconquerable determination, I studied some more, till I finally got my class A license at League Island Navy Yard. This entitled me to a seat in the ante-room of Dave Heilig, then port manager for Marconi, where I was in constant attendance, till my cash ran out, and the hopes oozed out at my boots. Well, I didn't pound the key for Marconi. I made pretzels out of conduit for various electrical contractors instead. Then, finally, KDKA started to broadcast. I robbed the kid's bank, bought a detector tube, and made a one-tube ultra audion out of some switches, reinforced cord, and No. 8 RC wire. Got her done on a Sunday afternoon, sat down, and twiddled the knobs. Finally, out of the silence, a powerful voice: "Jesus Christ" . . . (I jumped a yard and landed on all fours)—"is coming back to this earth!" I had tuned in on the Point Breeze M. E. Church sermon!

But shux! That's been a long time ago. My latest set is a masterpiece, according to all accepted standards. Wired with 3-inch x ½-inch busbar, salvaged from a switchboard, with remote control operated oil circuit breakers for filament control, each stage of amplification inclosed in a separate cabinet, made of ½-inch vanadium steel, etc. And boy! What results! Wheeee! Awrk! Squaaawk! Station WPX, Signor El Toro, will sing, "I Love My Baby!" Wheeee! But since the last issue of RADIO NEWS came out, I have made some wonderful improvements! I discarded the bomb-proof shielding cabinets, and put the units in bird cages, made of No. 14 wire, spaced 3/32 of an inch apart, all in accordance with the latest dope on shielding. And you ought to hear it now. Wheeee! Arwk! Station HEK now signing off. Wheeee!

Harry E. Korab, Ocala, Fla.

CONCERNING THE "DETECTORIUM"

Editor, RADIO NEWS:

It was with great interest that I read your article on Mr. Gernsback's Detectorium which appeared in the September issue of RADIO NEWS. I constructed this instrument in 1918 when I first commenced radio research. Details were then published in your handbook, "Wireless Telegraph and Telephony." The instance remains vivid in my memory as the tuner, when incorporated in a portable set was extremely efficient and decidedly unique. The only trouble that I experienced was due to the crystal. Silicon was the most satisfactory although it has a tendency to crumble. This applies to zincite while carborundum cannot be ground and is therefore not smooth in action. The tuning was extremely sharp, and when the secondary was shunted by a .0003-μf. variable condenser results were all that could be desired.

I take this opportunity to compliment you on the high standard of your publications, which with all due respect to our English periodicals, are on a much higher scientific basis. Our papers only cater to the broadcast listener, and the experimenter who dabbles in everything electrical is left in the dark.

W. M. Cox, EAA., Chatham, England.

REGARDING LIGHTNING ARRESTERS

Editor, RADIO NEWS:

In the October issue you published an account of the damage done by a lightning bolt striking an aerial.

From the tone of that article it seems to me that the writer of it expected, and apparently still expects, a lightning arrester to prevent damage to a radio set or to a house, in the case of an aerial being struck by lightning. Surely such incorrect views regarding lightning arresters are not general. Surely most of your readers know that if a lightning bolt ever strikes an aerial there is going to be damage and plenty of it, regardless of the number of lightning arresters installed in the circuit.

A moment's reflection should convince anyone that a lightning bolt, with a potential of probably millions of volts, cannot be carried, even for a fraction of a second, by a thin copper wire in the form of an aerial or house-wiring, or even by the heavier metalwork to be found on a house.

In the case of a lightning bolt striking an aerial, damage is inevitable (except in "freak" cases). The sole purpose of a lightning arrester is to prevent the formation of a sufficiently high electrical potential in the vicinity of an aerial, by draining off in the form of a trickle flow, any charge that forms in the vicinity of the aerial, and as soon as it forms. If the lightning arrester succeeds in draining off this charge as fast is it forms then it is a valuable protection not only to the radio set but to the house as well. If, however, a charge accumulates too fast to be drained off in this way then a lightning bolt is due to strike—not necessarily the aerial, but somewhere in the vicinity.

The foregoing explanation should not cause any alarm amongst readers. The function of a lightning arrester is the same today as it was yesterday, and will not be changed by anything published in RADIO NEWS. What is written here does not increase or decrease the chance of any aerial being struck by lightning but your readers should know that the purpose of a lightning arrester is to *prevent* a lightning bolt from striking an aerial and *not* to afford protection *after* the bolt has struck.

—David G. R. Henderson, New Cumberland, Pa.

(There seems to be a considerable misunderstanding of the exact function of the radio lightning arrester, and we believe your sincere attempt to explain the action makes matters worse instead of better.

True, a lightning arrester will not prevent damage due to a direct stroke of lightning. The stroke is too powerful. And contrary to the statement made in your letter, it will not prevent *lightning from striking the aerial by draining off the static charge in the immediate vicinity of the aerial. The aerial may be 50 feet above ground, whereas the charged cloud—the source of the stroke —may be a mile high.*

The real purpose of the lightning arrester is to arrest the high potential currents induced *in the aerial system by local discharges of lightning. Every time lightning discharges in the vicinity of the receiving aerial—it may be within a radius of several miles—sparks will jump across the arrester terminals to ground. Obviously, without the arrester, the induced current would be conducted to the antenna and ground posts of the set and would be liable to cause damage by setting fire to some part in or near the set.—Editor.)*

DOUBLE-GROUND RECEPTION

Editor, RADIO NEWS:

Ever since I purchased my radio last fall I have been "just dying" to experiment; but, being a woman and not much of a climber, besides not knowing much about electricity, I have been somewhat handicapped.

My set is a four-tube Atwater-Kent, used with an outdoor aerial, and grounded to the water pipe in the cellar. There is another pipe just outside the window which is driven six feet into the earth and is used for the "lightning ground."

After reading the article by Mr. L. L. Rice on "Underground Aerial Reception," appearing in the September issue of RADIO NEWS, I thought I would see if I could get anything by employing this outside ground connection.

Well, I simply took exactly 8½ feet of No. 14 rubber-covered wire and dropped it into the pipe, which is 2 inches in diameter, and then filled the latter with water. I attached the free end to the aerial binding post, taking the aerial off, of course, and turned the set on. I picked up WJZ immediately and the volume was the same as with my outdoor aerial.

In the evening I tuned in WTIC, Hartford, Conn. This was not quite as loud as usually received with the outdoor aerial.

It may be that a good number of people have tried an arrangement similar to the one I have outlined, but it was a new venture for me.

—Irene M. Miller, Meriden, Conn.

OUT OF THE VOID

A rather nebulous advertisement appeared in the *Jersey Observer* of Sept. 24 "Songbird Audio-Frequency and IMPENDENCE Transformers, $1.00." We sent Mike of the Investigation Dept. hot foot on this job, and he reports it is one of those *impending* matters. You know—way off in the distance.

Contributed by Henry Spillner, Jr.

OH, EAST IS EAST AND WEST IS WEST

Evident explication of Kipling's famous poem, as set forth in *The Windsor (Ont.) Border Cities Star* of Sept. 18. "Each radio channel reserved for the Dominion can be used in several ways—it will accommodate 2 stations, one in the EATS and . . . ." Or maybe stations just naturally *hunger* after something or other. Can you tell us?

Contributed by Russell Morgan

PLEASE, MR. FIREMAN, SAVE MY GROUND!

Fiery remarks from the *Cincinnati Enquirer* of Sept. 19, on speaking of ground connections: "It is advisable to BURN off the water at the main before soldering." Now suppose that the water does catch fire, as suggested, what on earth are they going to put it out with? 'Stoo *deep* for us!

Contributed by Louis F. Fuller

ADVICE TO SET BUILDERS

For the makers of the home made bloopers, the following advice was given on Sept. 3 in the *New York Daily Mirror:* "Try changing the tube and ALMOST look over the wiring." Now, boys and girls, you should all give heed to this counsel and give a look gradually witt de wiring.

Contributed by T. F. Maher.

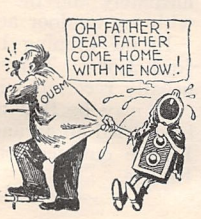
A NEW USE FOR SOCKS

Booming the stocking industry, as reported in the *Cleveland Press* of Sept. 16: "Preceding the banquet affair, Clyde Doer's SOXOPHONE Sextet was on the air." We suppose that the various sizes of the instruments come in the size of socks, viz; Bass, size 14; baritone, 10½; up to soprano which, we suppose, was filched from baby.

Contributed by Frank M. Walling.

I SAY, OLD THING, WHAT'S ALL THIS?

Cockney venture from the *Binghamton, N. Y., Press* of Sept. 28, "Radios, the kind that works just as good day or night; EAR REFORM STATIONS." Blimey, if some of these stations don't need a bit of reforming we miss our guess. Oh, well, what price radio?



Contributed by A. T. Pack.

NAVAJO OR SENECA?

Indian motif from the *Sheboygan (Wis.) Press* of Sept. 27: "How many TRIBES are there in the most popular sets?" We are getting more or less used to the daily marvels of radio, but we never did expect to see the day when sets would be provided with Indian encampments.

Contributed by Jos. Presse.

LIT UP LIKE A CHRISTMAS TREE

In the *San Francisco Examiner* of Sept. 26 we have this Volsteadian gesture: "Nationally known receiver, ALL batteries ILLUMINATED." We don't mind taking a quiet little nip now and then to keep our hair curly; but we do draw the line at young and innocent batteries getting "lickered up" like this.

Contributed by Bert Horton.

IF you happen to see any humorous misprints in the press we shall be glad to have you clip them out and send to us. No RADIOTIC will be accepted unless the printed original giving the name of the newspaper or magazine is submitted with date and page on which it appeared. We will pay $1.00 for each RADIOTIC accepted and printed here. A few humorous lines from each correspondent should accompany each RADIOTIC. The most humorous ones will be printed. Address all RADIOTICS to

Editor RADIOTIC DEPARTMENT,
c/o Radio News.

WAS THERE ANY SCANDAL?

And this from the *Houston, Texas, Post-Dispatch* of Sept. 19: in telling about some experiences in getting the proper sound of bells over the mike, the gentleman being interviewed is quoted as saying, "I remember DECENTLY when . . . ." We certainly hope that there hasn't been any scandal around—that we have missed.

Contributed by W. H. Wilcox.

WHAT IS SHE QUEEN OF?

In the *Baltimore American* of Sept. 26 we find this gem: "WLIT began broadcasting on MARY 24, 1923." Maybe the home paper of H. L. M. has been digging into history and discovered some queen that nobody ever heard of. Got any dope on this situation?

Contributed by Ben Amar, Jr.

'RAY FOR THE CAVEMAN!

In the *N. Y. Sun* of Sept. 25 we find this evolutionary note: "Special transformers are MALE by several manufacturers." We sent Mike of the Investigation Dept. out on this, and he found that some transformers are now in such a state of evolution that they are growing beards and have to shave. Draw your own conclusions.

Contributed by Norman Bernat.

NOT FOR US!

On Sept. 26 the *Cincinnati Enquirer,* in an article on aerials, had this rather startling note, "the WIFE may be either stranded or solid copper." Well we have heard of some wives being *stranded;* but as for the latter we prefer the sort that we are accustomed to.

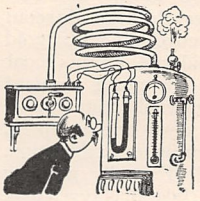
Contributed by Jos. Wolf.

JUST HUNTING FOR TROUBLE

In the *Pittsburgh Press* of Sept. 26 we find a new type of storage battery mentioned: "4-tube Air Way storage battery and loud-speaker." Now why on earth are they putting tubes in storage batteries and speakers? Isn't it enough to have 'em in the sets? Let well enough alone, say we.

Contributed by C. R. Kelly.

HOW HOT IS THIS?



In the Barawik Co's. catalog for 1926 we find a warm one. It says that their loop is "especially suited for center-tap SUPERHEATS." Back in the old days, when we were playing around boilers and stills, we heard a lot about superheaters, but this radio heater is a new one on us. Go on, we're listening!

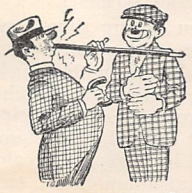
Contributed by Robert Ray

WUXTRY!! WUXTRY!!

Headlines of a startling nature seen in the Sept. 21 issue of the *Washington Daily News:* "Radio Riot Growing as New NATIONS are Licensed." We assume that it is the old story of not enough wavelengths to go around, with all these new countries springing up. Somebody please deal a new hand.

Contributed by N. T. Meeds.

HOW WE PROGRESS!

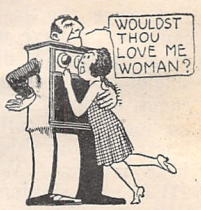


In the *Atchison (Kan.) Globe* of Sept. 21 there appears the following: "We have batteries, tubes, chargers, etc. in STICK." Is this some new fangled burglar-proof stunt? We sent Mike out again and he says it has something to do with Prohibition. Do you know what he means?

Contributed by J. C. Winiecke.

BIGGER AND BETTER CABINETS

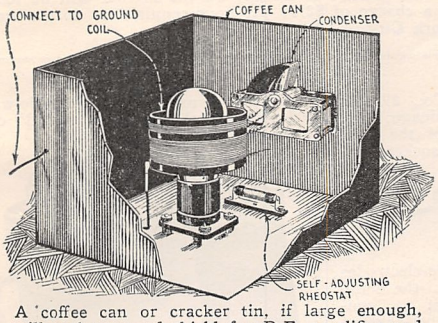
This from the *Cincinnati, Times-Star* of Sept. 15: "Trend in Cabinets is toward HE console." Yes, there's been lots of research work going on these last few years, and now you can see for yourself what it's all about. We just don't like to say, as we might be stepping on someone's toes.



Contributed by S. H. Moore.

COFFEE CANS FOR SHIELDING

Shielding has proven so effective in the laboratory that now practically all the good commercial sets are so constructed. Coffee cans make very excellent shielding for the



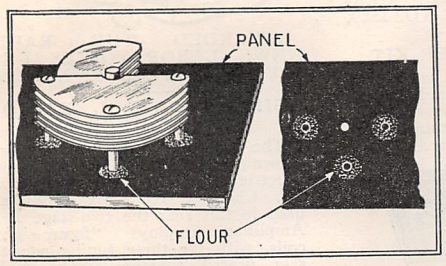
A coffee can or cracker tin, if large enough, will make a good shield for R.F. amplifier and detector units. There should be plenty of space between the coil and the sides of the can.

radio experimenter's set. Cans large enough for the various stages can be easily obtained. By placing the coil around the tube as shown and with automatic filament controls much space is saved. However, with some condensers mounted at an angle you will find plenty of room for a filament rheostat. Be sure to make large enough holes in the cans so they will not short circuit wires and other live parts passing through them. The cans may be fastened to the base-board with wood screws and grounded and the lids placed on them.

Contributed by Frank A. D. LaMater.

DRILLING PANEL HOLES WITHOUT A TEMPLATE

It is often difficult to properly locate holes for mounting condensers and other instruments without a template. A very simple



Placing the variable condenser flat on the rear of the panel and spreading flour around the mounting supports is a good method for locating positions for the holes.

way of doing this is as follows: The shaft hole is located first and drilled. The condenser or other instrument is then placed on the panel with the shaft through the hole, as shown in the illustration, with the condenser resting on the panel in the exact position in which you wish to mount it. A little white flour is then sprinkled on the panel around the instrument and the instrument is then removed. This leaves circles of flour around the bushings. The center of each circle is marked with a center punch and drilled. It will be found that holes so drilled line up perfectly.

Contributed by N. V. Churchill.

ENGRAVING PANELS

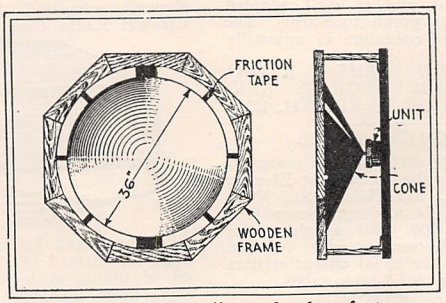
Builders of radio sets usually wish to have their panels engraved, to make a neat appearance and to give the cabinet a professional look. A simple method of doing this is to mark the arrows, letters, or whatever is to be engraved, on the panel with a lead pencil. A prick-punch with a sharp point is then used to go over the lines drawn, tapping lightly. With a little practice on a spare piece of hard rubber or bakelite, these punch marks can be made to give the panel a fine appearance. The small punch holes can be filled with engraving enamel or whiting, or can be left as they are.

The holes, or rather punch marks, should be spaced evenly and may be set close together or apart, as required to suit the personal taste.

Contributed by H. R. Wallin.

A 36-INCH CONE SPEAKER

Having tried various types and sizes of loud-speaker, I finally built the large one shown in the illustration and think it



Details of a very easily made three-foot cone speaker. A speaker with these dimensions gives remarkable results.

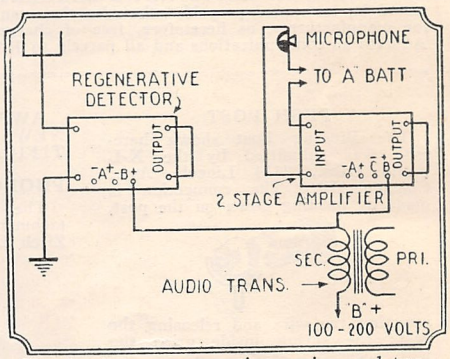
cannot be beat for volume and tone. I use a ten-tube superheterodyne and get extra strong signals, but this large cone does not chatter or blast. The wood can be cut out at any joiner shop, where they have a band and circular saw. Any good carpenter can get the information necessary from the accompanying illustrations. The floating three-foot cone is fastened to the wooden frame with friction tape. The cone unit is mounted at the rear as shown. The speaker is designed so that it can be hung on the wall and covered with an ornamental silk curtain if desired.

Contributed by Charles G. Cairns.

A NEW USE FOR THE OLD SINGLE CIRCUIT RECEIVER

A very simple radiophone transmitter, that operates well over a range of several miles, may be made out of the old three-tube regenerative set. All the additional parts required are a microphone and an audio transformer. They are connected as shown. Both the detector output and the amplifier output are short circuited.

By speaking into the microphone the voice currents are amplified and the transformer,



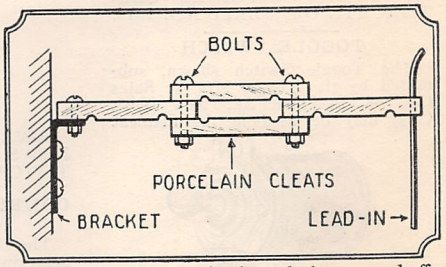
Showing how a regenerative receiver and two-stage A.F. amplifier can be converted into a radiophone transmitter.

modulates the output of the oscillating detector tube. The radiation can be increased considerably by replacing the detector grid leak with one of about 50,000 ohms. Although this is a low powered transmitter, a license for operating it should be obtained from the radio inspector.

Contributed by Frank Wilburn.

SIMPLE STAND-OFF INSULATOR

When transmitting at a low wavelength, the lead-in should be held at a distance at least five inches from the roof and walls of the building. This requires a good stand-off insulator. A simple one can be constructed out of ordinary porcelain cleats as shown in the illustration. Four of them are required, bolted together as shown. A bracket is used to mount the insulator to



As shown above, a simple and cheap stand-off insulator can be made from four ordinary porcelain cleat insulators, a few bolts and a support bracket.

the wall. Glazed porcelain cleats are recommended for this purpose.

Contributed by Donald L. Haladay.

A JACK PANEL

When more than two pairs of head phones are to be used on a receiving set, they should not all be connected in series, if best results are desired. Two pairs, if they are of the same impedance and make, can be connected in series all right, but if a third pair is to be used, it should be connected in parallel with the first two. All this is accomplished with the jack panel connection shown. When several pairs of

(*Continued on page* 714)

All published Wrinkles, not winning prizes, will be paid for at the rate of two dollars each.

The next list of prize winners will be published in the January issue.

RADIO manufacturers are invited to send to RADIO NEWS LABORATORIES, samples of their products for test. It does not matter whether or not they advertise in RADIO NEWS, the RADIO NEWS LABORATORIES being an independent organization, with the improvement of radio apparatus as its aim. If, after being tested, the instruments submitted prove to be built according to modern radio engineering practice, they will each be awarded a certificate of merit, and a "write-up" such as those given below will appear in this department of RADIO NEWS. If the apparatus does not pass the Laboratory tests, it will be returned to the manufacturer with suggestions for improvements. No "write-ups" sent by manufacturers are published on these pages, and only apparatus which has been tested by the Laboratories and found to be of good mechanical and electrical construction is described. Inasmuch as the service of the RADIO NEWS LABORATORIES is free to all manufacturers whether they are advertisers or not, it is necessary that all goods to be tested be forwarded prepaid, otherwise they cannot be accepted by the Laboratories. Apparatus ready for the market or already on the market will be tested for manufacturers, as heretofore, free of charge. Apparatus in process of development will be tested at a charge of $2.00 per hour required to do the work. Address all communications and all parcels to RADIO NEWS LABORATORIES, 53 Park Place, New York City.

PUSH POST

The Binding Post shown herewith was submitted by the X-L Radio Labs., 2424 Lincoln Ave., Chicago, Ill. The connection is made by pushing down on the post,

inserting the wire and releasing the post; the spring inside grips the wire securely.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1197.

RADIO-FREQUENCY TRANSFORMER

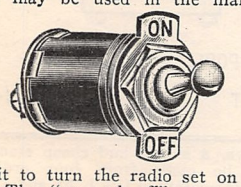
The "Proudfoot" Radio Frequency Transformer shown was submitted by the Cruver Mfg. Co., 2456 West Jackson Blvd., Chicago, Ill. With the ever-increasing number of broadcasting stations, selectivity is of

prime importance in receiving sets. The instrument illustrated is scientifically designed, and covers the broadcast band when connected to a .00035-mf. variable condenser.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1314.

TOGGLE SWITCH

The Toggle Switch shown, submitted by the Saturn Mfg. & Sales Co., 48 Beekman St., New York City, may be used in the filament

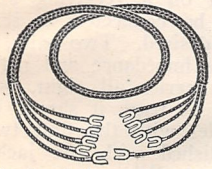


circuit to turn the radio set on and off. The "on and off" name plate furnished shows at a glance whether the circuit is closed or not.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1348.

BATTERY CABLE

The Battery Cable shown, submitted by the Birnbach Radio Co., 370 Seventh Ave., New York City, employs five wires with different-

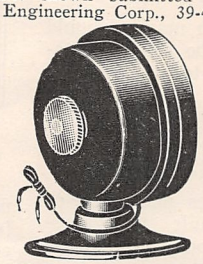


colored insulation, insuring accuracy and neatness in the battery connections.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1447.

PHONOGRAPH ATTACHMENT

The "Operola" Phonograph Attachment shown submitted by the Zisch Engineering Corp., 39-43 Ave-



nue L, Newark, N. J., has an adjustable unit and is well adapted for the phonograph tone-arm. The quality of reproduction is unusually good.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1558.

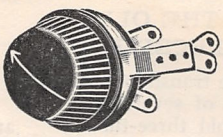
VACUUM TUBES

The "Armor" Tube shown, submitted by the Armstrong Electric & Mfg. Co., 351 Halsey St., Newark, N. J., is a detector-amplifier, type C.F. 500, and employs the modern UX socket with bakelite base. It has the usual characteristics found in the 201A-type tubes.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1566.

COMBINATION SWITCH AND RHEOSTAT

The Midget Rheostat with Filament Switch shown, was submitted by the Carter Radio Co., 300 South Racine Ave., Chicago, Ill. While the ordinary filament rheostat may be used also as a switch to close the circuit of the tubes which it controls, it can not be used to turn on the other tubes in the set.

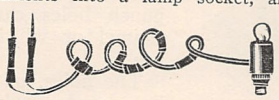


The combination switch and rheostat illustrated is designed for this purpose. Turning the knob to the right automatically closes the switch.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1580.

TEST HANDLES

The "Universal" Trouble Shooter shown were submitted by the Universal Test Equipment Co., 2939-41 No. Oakley Ave., Chicago, Ill. On screwing the plug of these instruments into a lamp socket, and

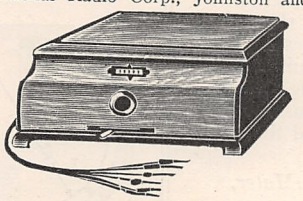


touching the two handle-electrodes to the device under test, the lamp will light if the circuit is continuous. Flexible rubber-covered cable is employed. Either a 6-volt or 110-volt lamp may be used.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1583.

VARIOMETER-TUNED RECEIVER

The "Rotofor" Radio Receiver shown, submitted by the International Radio Corp., Johnston and



Alhambra Ave., Los Angeles, Calif., employs, instead of the usual method of tuning with variable condensers, three variable inductances of the variometer type, geared to one control knob. It contains five tubes and is built into a drawer which may be removed from the cabinet.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1589.

SIX-TUBE RECEIVER KIT

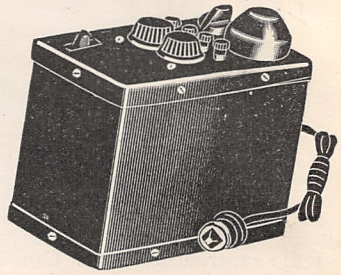
The "Somerlog Dymac-Kit" shown, submitting by the Electrical Products Mfg. Co., 619 Sprague St., Providence, R. I., contains three "figure-eight" coils, three fixed

balancers, one by-pass condenser and one set of constructional drawings, showing how to build a six-tube set. The parts are well made, and when they are used in the circuit designed for them, very good results are obtained.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1590.

"B" ELIMINATOR

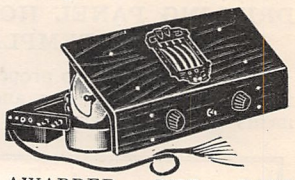
The "Kingston" "B" Eliminator shown, submitted by the Kokomo Electric Co., Kokomo, Ind., is of excellent construction, both electrically and mechanically. It is designed for use with the double-wave Raytheon tube, and delivers "B" current at voltages up to 150.



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1596.

SEVEN-TUBE RADIO RECEIVER

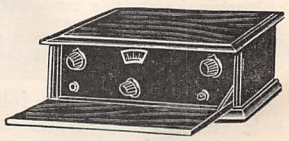
The Radio Receiver shown, submitted by the Alden Manufacturing Co., Springfield, Mass., employs a three-stage R.F. amplifier tuned with the "Na-Ald Localized Control" variable condensers, a detector, and a three-stage Donle impedance-coupled audio amplifier. The units are well shielded, and the set responds with good quality and volume throughout the entire broadcast range.



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1598.

SINGLE-CONTROL RADIO RECEIVER

The "Apex" Radio Receiver shown was submitted by the Apex Electric Mfg. Co., 1410 West 59th St., Chicago, Ill. Six tubes are used in this set; the two-stage R.F. Amplifier employs "figure-eight" coils, with the three tuning condensers geared together. The audio



amplifier is of the three-stage impedance-coupled type. The front of the cabinet may be closed when the set is not in use.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1605.

ANTENNA PLUG

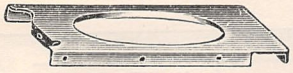
The Antenna Plug shown, submitted by Leslie F. Muter Co., 76th St. & Greenwood Ave., Chicago, Ill., is one of the simplest manufactured. It consists of a standard lamp-socket plug receptacle into which is placed a one-pole plug connected to one terminal of a fixed

condenser. The other terminal is connected to the binding post shown. The plug may be removed and reversed.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1609.

SUB-PANEL BRACKET

The Sub-Panel Bracket shown, submitted by the American Radio Hardware Co., 203 Lafayette St., New York City, is stamped out of one piece of sheet aluminum. The

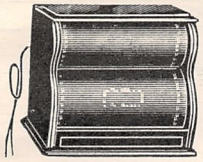


shape is such that it is unusually strong. It is 2⅜ inches high.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1610.

LOUD-SPEAKER

The "Dictograng" Loud-Speaker shown was submitted by the Dictograph Products Corp., 220 West 42nd St., New York City. The



vibrating unit, or reproducing member, of this speaker is in the shape of two semi-cylindrical rolls of material, such as is used in cone-speakers. One roll, being larger than the other, covers a different frequency-range; and the combination of the two gives the instrument good characteristics. The driving unit is in the center.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1612.

CRACKLE-SURFACE PANEL

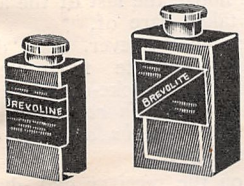
The Crackle-Surface Panel shown, submitted by the American Hard Rubber Co., 11 Mercer Street, New

York City, is of the same high grade rubber used in Radion panels. The crackle surface removes the glossy effect and gives the panel a more finished appearance.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1614.

RADIO CEMENT

This "Brevolite" Radio cement, submitted for test by the Waukegan Chemical Co., Waukegan, Ill., is furnished usually with the Brevoline



Thinning Solvent. It will be found useful in the construction of radio parts, such as inductance coils.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1615.

SPAGHETTI

The Spaghetti shown, submitted by William Brand & Co., 27 East 22nd St., New York City, is finished in red and black and is very flexible.

AWARDED THE RADIO

NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1616.

RUBBER COVERED BRAID

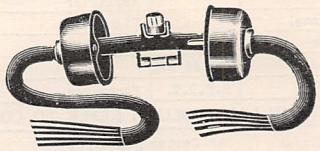
The Rubber Covered Braid shown, submitted by the Belden Mfg. Co., 2300 S. Western Ave., Chicago, Ill., has five stranded cables, each separately insulated with different

colored insulating material, and bound together into one cable. It is designed for radio-battery connection leads.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1617.

FUSED BATTERY CORD

The Fused Radio Battery Cord shown, submitted by the Belden Mfg. Co., 2300 S. Western Ave.,

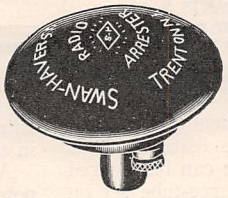


Chicago, Ill., is provided with fuses for both "A" and "B" battery circuits, thereby protecting tubes against overloads. The bakelite case is easily opened for replacing fuses.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1618.

LIGHTNING ARRESTER

The "Safe Guard" Lightning Arrester shown was submitted by Swan-Haverstick, Inc., Trenton, N.

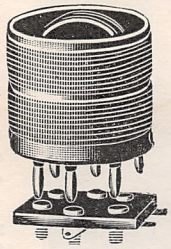


J. As a protection against high-voltage induction in the aerial system, as a result of local lightning discharges, a lightning arrester is essential. This one complies fully with the underwriters' requirements.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1620.

RADIO-FREQUENCY COIL

The plug-in Radio-Frequency Coil shown, submitted by the Thor Radio Mfg. Co., 35 So. Dearborn St., Chicago, Ill., has a rotor inside and two windings on the outer tube. It

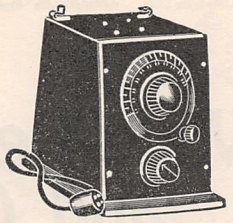


may be used for the oscillator circuit of a Superheterodyne or for other purposes. The plug-in feature is well made, and by its use a wider wavelength range may be obtained with different sizes of coils.

AWARDED THE RADIO NEWS LABORATORY CERTIFICATE OF MERIT NO. 1623.

SHORT-WAVE RECEPTION ATTACHMENT

The "Submariner" shown, submitted by the J-M-P Mfg. Co., 172 Seventh St., Milwaukee, Wis., tunes down to the short waves, which are fed into the audio amplifier of the ordinary broadcast receiver, by in-



serting its plug into the detector socket of the set. A socket is provided on the top of this instrument for the short-wave detector tube.

AWARDED THE RADIO NEWS LABORATORY CERTIFICATE OF MERIT NO. 1624.

VACUUM TUBE

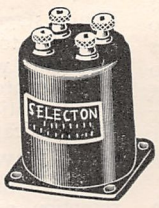
The "Ureco" Vacuum Tube shown, submitted by the United Radio & Electric Corp., Newark, N. J., employs the modern UX

type socket with bakelite base. It has the usual characteristics found in the 201-A-type tubes.

AWARDED THE RADIO NEWS LABORATORY CERTIFICATE OF MERIT NO. 1625.

LONG-WAVE TRANSFORMER

The "Selectone" Long-Wave Transformer shown, submitted by the Scott Radio Laboratories, 34 South Dearborn St., Chicago, Ill., may be used with an intermediate amplifier in superheterodynes or any other circuits where a long-wave transformer is specified. The transformer is enclosed in a molded

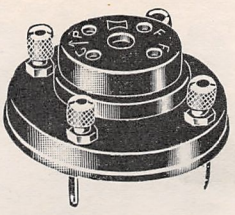


case, with the primary and secondary terminals at the top. There are two types, 400 and 410; one is more sharply tuned than the other, covering a range of 6,000 to 8,000 meters.

AWARDED THE RADIO NEWS LABORATORY CERTIFICATE OF MERIT NO. 1627.

SPRING-CUSHION SOCKETS

The "Na-Ald" Spring-Cushion Socket shown, submitted by the Alden Mfg. Co., 54 Willow St., Springfield, Mass. The phosphor-bronze spring contact strips of this socket also support the central por-

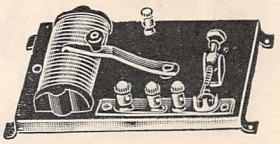


tion, and thereby reduce vibration of the tubes. It is of the UX type.

AWARDED THE RADIO NEWS LABORATORY CERTIFICATE OF MERIT NO. 1628.

CRYSTAL RECEIVER

The "Pal" Crystal Radio Receiver shown, submitted by the Pal Radio Co., 1204 Summit Ave., Jersey City,

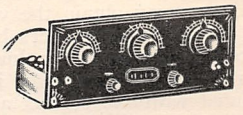


N. J., works very well when used with an efficient aerial. It covers the broadcast range, and occupies small space.

AWARDED THE RADIO NEWS LABORATORY CERTIFICATE OF MERIT NO. 1629.

TUNED-R.F. RECEIVER

The "BST-5" Radio Receiver shown, submitted by the Guaranty Radio Goods Co., 145 West 45th St., New York City, is of the 5-tube-R.F. variety, employing "spider

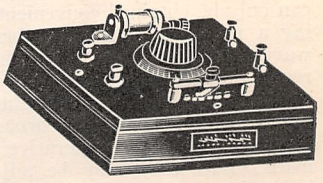


web" R.F. coils and a transformer-coupled audio amplifier. The set is well built and gives very good reception.

AWARDED THE RADIO NEWS LABORATORY CERTIFICATE OF MERIT NO. 1630.

CRYSTAL RECEIVER

The Crystal Receiver shown, submitted by the Steinite Laboratories, Radio Bldg., Atchison, Kans., gives unusually good results on local re-



ception; and with a good aerial installation and sensitive headset, distance reception is possible.

AWARDED THE RADIO NEWS LABORATORY CERTIFICATE OF MERIT NO. 1631.

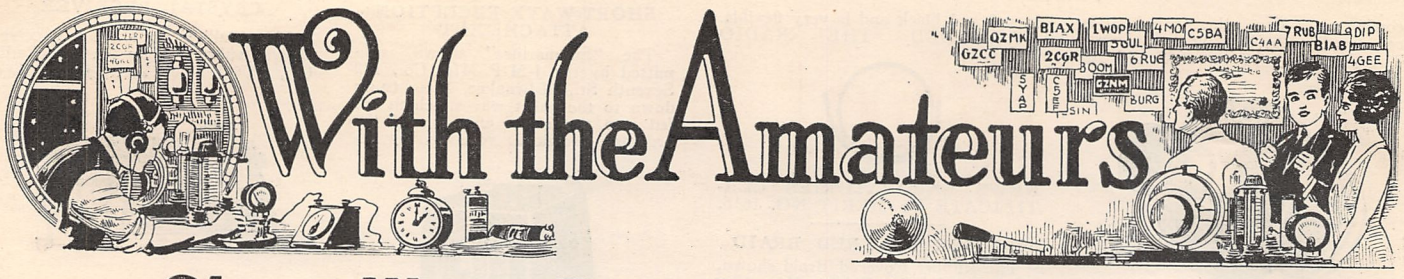
CONSOLE RADIO RECEIVER

The "Crosley" Radio Receiver, "Model 5-75," shown, submitted by the Crosley Radio Corp., 1132 Alfred St., Cincinnati, Ohio, is of the console type, with the Crosley "Musicone" mounted in the lower

section, and employs five tubes. The three tuning condensers are mounted on one shaft and controlled by the drum-type dial. The set is neat in appearance and performance and fills the average broadcast receiving requirements.

AWARDED THE RADIO NEWS LABORATORY CERTIFICATE OF MERIT NO. 1632.

(*Continued on page* 757)



Short-Wave-Receiver Adjustment and Operation

Applying to all arrangements, but particularly to the "Schnell" circuit

By A. BINNEWEG, JR., 6BX, 6XAA.

GRADUALLY, as short wave knowledge increases and the value of these waves for DX becomes more apparent, more and more experimenters are adjusting their receivers so that they, too, may obtain the wonderful results that earlier experimenters have found to be so commonplace on the lower wavelengths. It is true that anyone who is thoroughly acquainted with the correct adjustment of an ordinary "three-circuit" regenerative receiver will experience little difficulty on the shorter waves, provided he has the patience to employ "cut-and-try" methods.

It is the purpose of this article to point out how some of the common difficulties, experienced by those new to the short-waves, may be overcome and to offer suggestions for securing maximum efficiency from a time-tested circuit that has secured, and is securing, such wonderful results for amateurs all over the world. These suggestions will in general be applicable to most all short-wave receivers.

The reception of continuous-wave signals can only be obtained conveniently by employing a regenerative circuit; hence all short-wave receivers developed by the amateur are regenerative and are, almost without exception, built around the straight, three-circuit regenerative idea. Some broadcast listeners imagine that all regenerative receivers, no matter how they may be adjusted, always have that rather objectionable tendency to "howl." Any regenerative receiver that "howls," however, is not operating properly and is "on the air" as far as the rest of the neighborhood is concerned; suggestions will be given for proper adjustment.

Any such circuit, if properly operated on short-wave broadcast reception, is all right; it is the amplifying equal of one or two ordinary stages of radio-frequency amplification, due to the regenerative feature. It is surprising what good volume can be secured from an ordinary two- or three-tube set on distant stations when reception conditions in the broadcast band are unfavorable.

SYMBOL	Quantity	NAME OF PART	VALUE OF PART	REMARKS	MANUFACTURER ★	
	1	Var. Cond.		7 plates	1	7,10,18
	1	Var. Cond.		10-Plate Throttling	1	7,10,18
	1	Rheostat	30 ohm		2	9,11,17
	1	Socket		Detector - Pyrex	3	
	1	Socket		Amplifier	3	10,18,1
	1	A. F. Trans.		High Ratio	4	10,16,19
	1	Grid Leak		Variable	5	11,20,21
	1	Grid Cond.	.00025 mf.		6	15,11,8
	1	Switch	S.P.D.T.	Porcelain	8	12,13,14

NUMBERS IN LAST COLUMN REFER TO CODE NUMBERS BELOW.

1 Bremer-Tully Mfg. Co.	17 Carter Radio Co.	33
2 Kloesner Radio Co.	18 Amsco Prod. Inc.	34
3 Garod Corp.	19 Samson Elec. Co.	35
4 Radio Corp. of America	20 Allen Bradley Co.	36
5 Durham & Co.	21 Central Radio Lab.	37
6 N. Y. Coil Co.	22	38
7 Hammarlund Mfg.	23	39
8 Leslie F. Muter Co.	24	40
9 H. H. Frost, Inc.	25	41
10 Pacent Elec. Co., Inc.	26	42
11 Electrad, Inc.	27	43
12 Barkelew Elec. Mfg. Co.	28	44
13 Westinghouse Elec. & Mfg. Co.	29	45
14 Circle F Mfg. Co.	30	46
15 Aerovox Wireless Corp.	31	47
16 All American Radio Corp.	32	48

APPROXIMATE COST OF PARTS $ 18.00

Form Copyright 1926 E. P. Co.

★THE FIGURES IN THE FIRST COLUMN OF MANUFACTURERS INDICATE THE MAKERS OF THE PARTS USED IN THE ORIGINAL EQUIPMENT DESCRIBED HERE.

HOW TO AVOID BLOOPING

One of the worst enemies of good distant reception, perhaps, is a regenerative receiver operated by an unskilled listener. This was brought out quite forcibly during the last International Tests. Perhaps a few words in this conection may be of advantage.

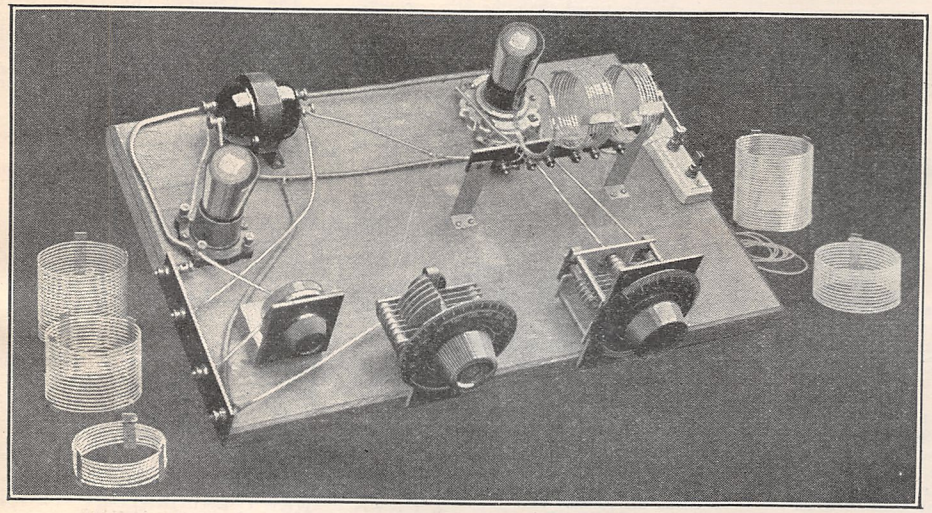
An oscillating receiver is simply a low-power transmitter; hence it may be well to describe how such a transmitter is adjusted for *maximum* output, so that none of these adjustments may accidentally be made. It is adjusted to oscillate as strongly as possible at the particular wavelength, after which the antenna coil is closely coupled to the secondary and tuned into resonance with it.

It is obvious that the reverse of the above should be followed if the set is to approach the non-radiation goal; that is, *loose coupling should be used, the set should not be allowed to oscillate and the antenna circuit should not be resonant with the secondary.* If loose coupling is used and no "dead-spots" are noted, the last of the above requirements is taken care of.

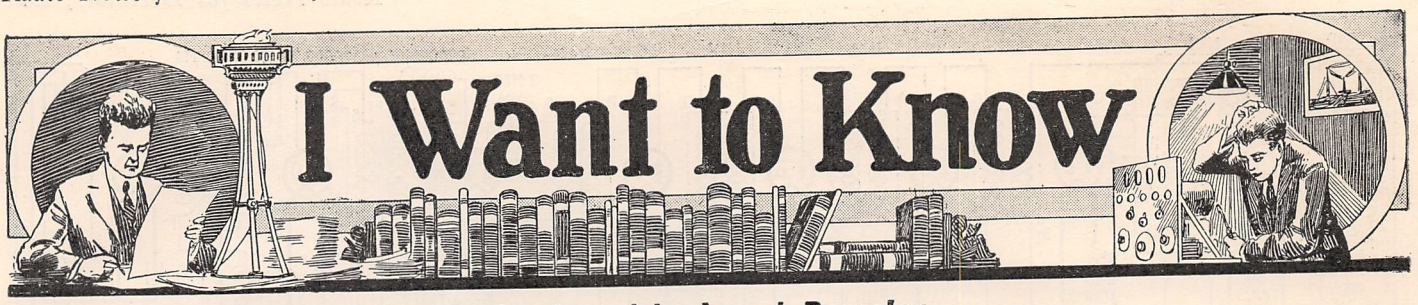
It should be noted, however, that "dead-spots" may also originate from nearby electric-light wiring, choke-coils, wave-meters, etc. *Any circuit in resonance with a sensitive receiver may be detected at a distance of several feet.*

"Dead-spots" on the receiver dial, due to resonance effects, are seldom encountered on the short-waves if a large antenna is used, which should be the case if greater volume and DX are desired. Loose-coupling reduces these effects. Probably the best and easiest method of eliminating them if found, is to change the wavelength of the antenna system. This may be done by changing its

(*Continued on page* 741)



The short-wave receiver constructed by Mr. Binneweg. The Schnell circuit is employed. Note the double spacing between the plates of the low-capacity variable condensers.



Conducted by Joseph Bernsley

THIS Department is conducted for the benefit of our Radio Experimenters. We shall be glad to answer here questions for the benefit of all, but we can publish only such matter as is of sufficient interest to all.

1. This Department cannot answer more than three questions for each correspondent. Please make these questions brief.
2. Only one side of the sheet should be written upon; all matter should be typewritten or else written in ink. No attention paid to penciled matter.
3. Sketches, diagrams, etc., must be on separate sheets. This Department does not answer questions by mail free of charge.
4. Our Editors will be glad to answer any letter, at the rate of 25c. for each question. If, however, questions entail considerable research work, intricate calculations, patent research, etc., a special charge will be made. Before we answer such questions, correspondents will be informed as to the price charge.

Mr. Bernsley answers radio questions from WRNY every Thursday at 8:15 P. M.

SUPER-PLIODYNE 9-TUBE RECEIVER

(Q. 2194) Mr. D. Stanley, Tuxedo, N. Y., asks as follows:

Q. 1. Please furnish me with the schematic wiring diagram of the Super-Pliodyne 9-tube receiver, which incorporates a special means of controlling oscillations in the R.F. stages, six stages of tuned-radio-frequency amplification, detector and two stages of audio. Also any constructional data or constants.

A. 1. This receiver is manufactured by the Golden-Leutz Co., Long Island City, N. Y., and the following information is published by their courtesy. All the variable condensers (C1, C2, C3, C4, C5, C6 and C7,) are .0005-mfd. capacity. These condensers are all geared together, thus giving you one dial for control. The transformers employed allow broad tuning. This is the reason for the use of so many stages tuned simultaneously.

The primaries (L1, L3, L5, L7, L9, L11, L13,) consist of 25 turns, wound on 1¾-inch tubing. The secondaries (L2, L4, L6, L8, L10, L12, L14,) consist of 100 turns wound on 2-inch tubing. No. 26 D.C.C. wire is used. The primary tubing is placed inside of the secondary tubing. The primary winding is spaced. Between every primary turn, allow a space equal to three turns, or about 1/8-inch.

The resistors (R1, R2, R3, R4, R5,) in the neutralized stages are variable, although not indicated as such. They vary from 20,000 to 120,000 ohms. The condensers in these stages are also variable, being of the regular midget type. C14 is the grid condenser, having a capacity of .00025-mf. R10 is the grid leak, having a resistance of from 1 to 3 megohms.

The filaments of all the R.F. tubes are controlled by a single rheostat, R6, which has a resistance of 6 ohms, and should pass 1½ amperes. The filament of the detector tube is controlled by a 20-ohm rheostat, R8. The filaments of the A.F. tubes are controlled by a single 10-ohm rheostat, able to pass ½-ampere. Tubes of 201-A or 301-A type are used throughout, with a 6-volt "A" battery. C13 is a .003-mf. fixed condenser. R7 is a 400-ohm potentiometer, used to control the oscillatory action of the tube.

Wiring the Receiver

The beginning of the primary winding is brought to the antenna post, and the other end to the ground post and to the beginning of the secondary winding L2. This same lead is extended to the arm of the rheostat, R6, and to the "A—C+" post. The rotor plates of all the variable condensers and the beginnings of the secondary windings of all the coils, except L12, are connected to this same lead. This gives all the tubes in these circuits a negative grid return. The beginning of the secondary winding, L12, is brought to the arm of the potentiometer, R7, and the resistance terminals of this potentiometer are brought to the "A+" and "A—". Although the grid return through the secondary winding, L14, is to "minus," a positive bias is obtained on this detector tube by connecting the grid leak in shunt to the grid and "A+."

The beginnings of these secondaries (L2, L4, L6, L8, L10, and L12,) are brought to the grid posts of their respective sockets, and the beginning of L14 to one terminal of C14. The other terminal of this condenser is brought to the grid post. The beginnings of the secondary windings (L2, L4, L6, L8, and L10,) are also connected to the resistors in their stages, while the other terminals of these resistors are connected to the fixed condensers. The other terminals of these condensers are brought to the plates of their respective tubes. No such resistor and condenser are connected to the sixth R.F. tube, the potentiometer taking its place. The rheostats are all connected in the negative legs of the respective filament circuits which they control. The variable condensers are connected in shunt to the secondaries, the rotor leads going to the filament side and the stators to the grid side.

Batteries Required

The plates of the R.F. and the A.F. tubes should receive about 90 volts ("B+Amp."); that of the detector tube about 45 volts ("B+Det."). A 4.5-volt "C" battery ("low") should be used as a grid bias in the first stage of A.F. coupling, and a 9-volt "C" battery "High" in the last stage.

The first variable condenser can be controlled independently of the other six which may be ganged. This may lead to easier synchronization of dials and louder signals.

The complete set is housed in a totally-shielded cabinet, with the coils placed so that practically no field exists between them; this is to prevent interstage coupling and consequent uncontrollable oscillations of the tubes in these circuits.

If a power tube is desired in the last stage, it would be best to isolate the "B" and "C" voltages that connect to this stage. A voltage not exceeding 135 should be used for the UX112 tube, and about 175 for the 171 tube; 9 volts "C" battery for grid bias with the first tube and approximately 22½ volts "C" battery for the latter.

The amount of amplification obtained from this receiver is tremendous, which permits loop reception. The loop connections are made to the grid of the first tube and to the "A—" terminal instead of to L2.

MADISON MOORE SUPERHETERODYNE

(Q. 2195) Mr. J. S. Cody, Waterbury, Conn., asks as follows:

Q. 1. Have you any information or diagram available on the Madison Moore Superheterodyne receiver? Have heard this super discussed many times at radio fan gatherings, and some of the remarks made me conclude that it must be highly efficient. If you can furnish me with the information, please include the values of the parts employed, and any other information which might be of interest and help to me.

A. 1. The schematic wiring diagram with the values of the parts indicated over their respective symbols is shown in Fig. 2195.

Some of the remarkable features of the Madison Moore Superheterodyne are that there is no body capacity or other inductive effects or pick-up; due to the fact that all of the accurately-tuned air-core transformers employed are shielded. All of the metal shields are grounded to the "A—" terminal.

The oscillator is specially designed and connected in an entirely novel manner, the pick-up coil being placed in the plate circuit of the first detector, as the diagram shows. This helps to eliminate noise and other effects of placing the pick-up coil in the grid circuit; and moreover it eliminates the usual superheterodyne annoyance of tuning in a station at two or more points on the dials of the condensers.

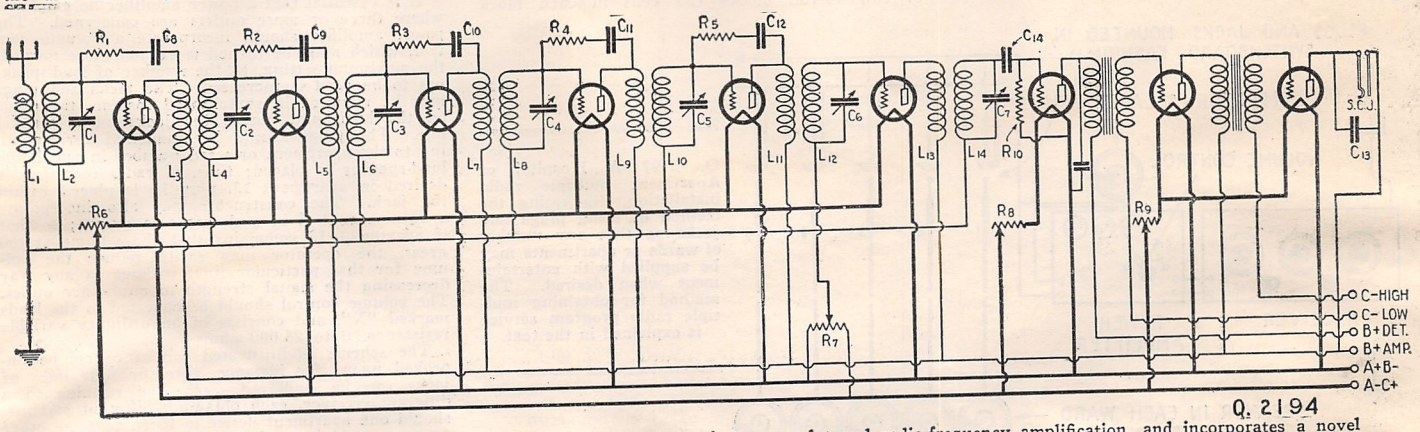
Some Special Features

No potentiometer is employed in this superheterodyne circuit, and no "C" battery is used on the I.F. amplification tubes, as in previous circuits where the potentiometer has been eliminated. A potentiometer may be inserted in the circuit for controlling the grid bias on the intermediate-frequency tubes if desired. One source of noise (namely, the grid leak and grid condenser in the first detector circuit) is eliminated by the use of a 4½-volt "C" battery, connected in series with the loop and grid.

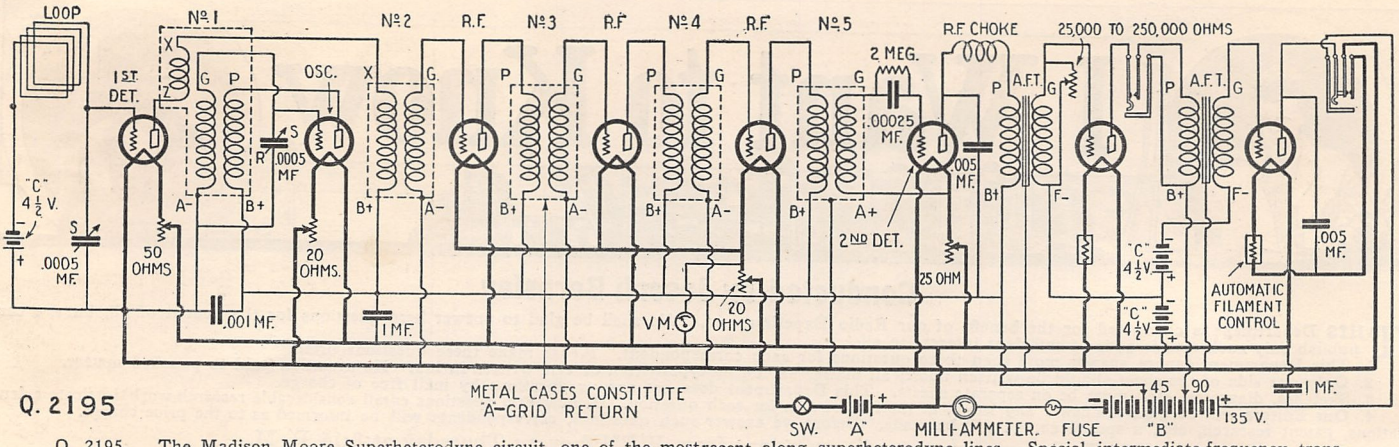
High-resistance rheostats are used on the tubes in order to give accurate and smooth control over a considerable range; the tubes having to burn at only a dim brilliancy, another source of noise is eliminated. It is best to use shockproof sockets for all tubes, or else to mount the sockets on a piece of bakelite, suspended on rubber bands. The metal shields on all the I.F. air-core transformers are grounded to the "A—" terminal; except in the case of the No. 5 unit, which has a wire running from "A—" to the lug on the shield. A radio-frequency choke coil is placed in series with the primary of the first audio transformer. The iron cores or shells of the transformers are grounded to the "A—", as well as the rotor plates of the two principal tuning condensers. It is best to place one of the new protective fuses in series with the "B—" battery line.

Option of Tubes

If fairly strong signal or voice is desired on the loud-speaker, a UX112 tube can be used in the second audio stage, with a 9-volt "C" battery, as



Wiring diagram of the Super-Pliodyne 9-tube receiver, which employs six stages of tuned radio-frequency amplification, and incorporates a novel means of suppressing oscillations. The amount of radio-frequency amplification obtained is tremendous, resulting in a very sensitive and selective receiver.



Q. 2195. The Madison Moore Superheterodyne circuit, one of the mostrecent along superheterodyne lines. Special intermediate-frequency transformers are designed for the 199 and 201-A type of tubes, which make possible perfect matching between tubes and transformers, and result in the utmost quality possible to obtain when using either type of tube.

indicated in the diagram. The 4½-volt "C" battery is sufficient for both A.F. tubes if UX201-A tubes are employed throughout. UX199 3-volt tubes can be used in this superheterodyne, its manufacturers supplying specially-designed tuned-air-core transformers for these tubes. The small tubes can be used with the transformers supplied for use on the UX201-A, but results obtained are not satisfactory as with transformers of the proper impedance for the type of tube selected.

The volume control, comprising a graphite compression unit giving a range of from 25,000 to 250,000 ohms, is connected across the secondary of the first A.F. transformer, as shown. The voltmeter and milliammeter may be dispensed with if the constructor does not care to purchase them. Only the best grade of rheostats and by-pass condensers should be purchased, as these are two probable sources of noise, especially in superheterodynes. The rheostat used to control the oscillator tube should be of the very highest quality; as variations in the resistance, due to a faulty rheostat, will cause changes in the frequency. In such a case the signal will fade and the set will not be satisfactory. Cheap by-pass condensers are other bad offenders, if they begin to leak. The operator may never suspect that these are the source of the noise, which resembles a steady steaming sound.

The tuned-air-core transformers, of the shielded type utilized in this set, may be placed about 3 inches apart in a row at the rear of the base, with six of the tube sockets spaced in between them. When using these shielded transformers, there is no danger of picking up noises from house-lighting circuits, etc.; and, unlike other superheterodynes of the unshielded type, it is also impossible for this set to pick up a station unless the loop is actually connected in. Such reception shows that the various intermediate transformers are picking up radio waves; and it can readily be seen that a set which does this is not likely to tune sharply, and also that there is liable to be trouble from picking up more than one station at a time, as well as interference from nearby lighting and power circuits.

In constructing these I.F. units, the transformer condenser is not varied to tune the transformer, in connection with an oscillator and wave meter as is often done; but the number of turns on the secondary is changed until the circuit is balanced to within a fraction of 1% accuracy.

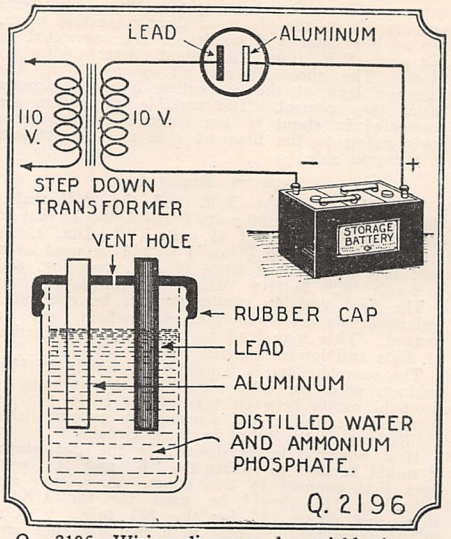
Note that the grid return of the second detector goes to the "filament plus" on the tube socket. Be sure to test all rheostats, and all condensers, including the fixed unit, to see that they are not short-circuited or open-circuited before you install them. It is important to keep the "A" battery always well charged in operating superheterodynes, and a storage "B" battery is desirable.

TRICKLE CHARGER

(Q. 2196) Mr. J. K. Stone, Christopher, Ill., asks as follows:

Q. 1. I would like to construct a trickle charger, one which can be used with a storage battery even while the set is in operation. Can you furnish me with any constructional information and other data which will enable me to construct this device?

A. 1. The parts necessary for the construction of the trickler charger are a step-down transformer (toy-train type, or bell-ringing transformer, with approximate output of 10 volts)



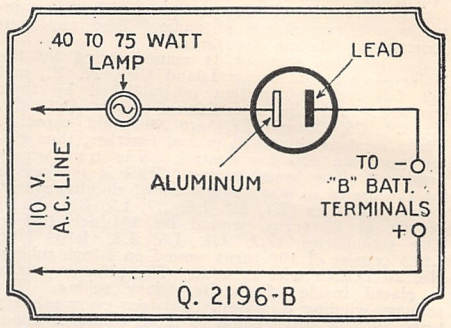
Q. 2196 Wiring diagram of a trickle-charging system, and the construction of a chemical rectifier employed in trickle chargers.

and a chemical rectifier cell, consisting of a fruit jar, one aluminum rod element and one lead element, approximately ½-inch in diameter and supported by a rubber cap (see illustration). The solution employed is a saturated solution of ammonium phosphate and distilled water.

Arrangement For Storage "B" Battery Charger

Q. 2. Can I employ the same device for charging my storage "B" battery, which is composed of two 46-volt blocks (23 cells in each block, two volts to each cell, lead-plate type battery.) If not, please furnish me with details of construction of a storage "B" battery charger that will operate economically and satisfactorily.

A. 2. It is impossible to employ the trickle charger as arranged in Fig. 2196 for charging a storage "B" battery; the voltage output is insufficient.



Q. 2196-B The parts and connections necessary for a "B" battery charger, operating from an A.C. source are shown. With this device, it is possible to charge only one 45-volt block at a time.

However, the changes in wiring, and necessary additions to convert it into a "B" battery charger, are really very few and simple. A 75-watt lamp in place of the step-down transformer and a few changes in the connections are all that are required. The wiring diagram for this device is shown in Fig. 2196-B.

MULTIPLE RADIO INSTALLATION

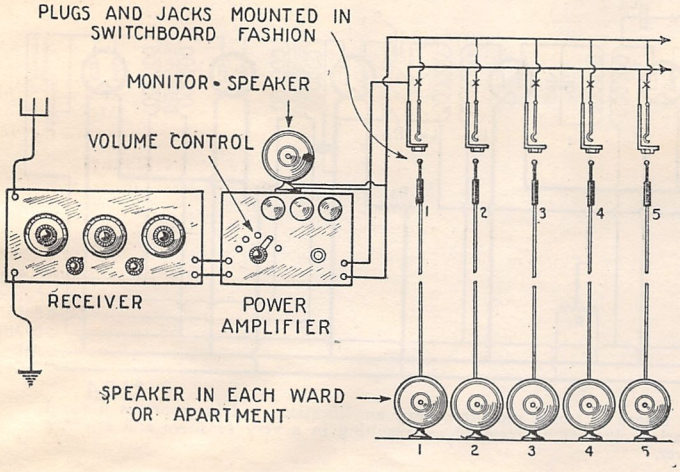
(Q. 2197) Mr. D. Wilkerson, Norwood, N. J., asks:

Q. 1. I wish to make a multiple radio installation in an apartment building. Can you furnish me with any data or diagram of the method of procedure?

A. 1. The system employed for making a radio installation where a number of outlets or loud-speakers are to be used, as in hospitals, hotels or apartments, has often puzzled a good many constructors and radio-set builders. The I Want to Know Department of Radio News has received numerous letters which show interest in this subject. We here present a diagram of a simple installation which, when completed, is a neat and interesting affair.

It is essential that a power amplifier be employed where three or more outlets are concerned. The power amplifier should incorporate a volume control, which must be turned more and more towards the maximum setting, as the number of loud-speakers to be used is increased. The jacks and plugs may be mounted in switchboard fashion, the plugs on the horizontal board, the jacks on a vertical one. The plugs should be numbered corresponding to the apartment or ward number in which the loud-speaker is placed; thus, if radio reception is desired in apartment 13, plug 13 is placed within the jack. The constructor may also incorporate a volume control in each separate output; so that if apartment 13 complains that the volume is too great, the operator may easily reduce the volume for that particular line, without in any way decreasing the signal strength to any other outlet. The volume control should be conected to the leads marked "X", and consists of an ordinary variable resistance, 0 to 25,000 ohms.

The scheme as illustrated can of course be improved upon; for instance, three or four lines of jacks can be employed, each line running to a different receiver, each obtaining different stations, should one apartment desire to listen to some other program. Also, a common connection might be used for the installation of the loud-speaker, instead of two separate wires for each outlet, which is a somewhat tedious and laborious installation.



Q. 2197 A Hospital or Apartment multiple radio installation, illustrating the method of using plugs and jacks so that any number of wards or apartments may be supplied with entertainment when desired. The method for obtaining multiple radio program service is explained in the text.

7 Tube Set
Single Dial Radio

30 DAYS FREE TRIAL

The Metrodyne

ONLY ONE DIAL TO TUNE

Retail Price
$75
Completely Assembled
Big Discounts to Agents and Dealers

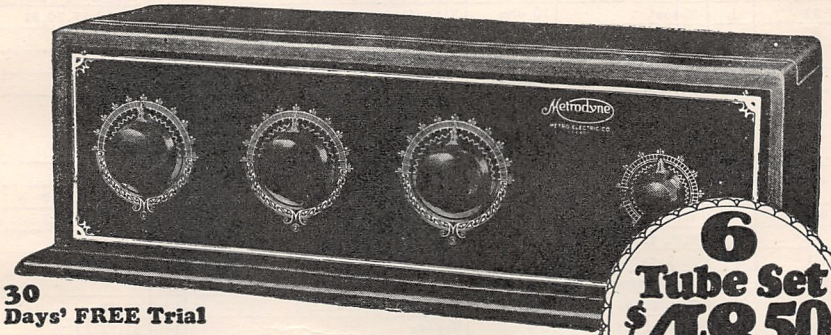
Wonderful offer direct from the factory! The world's greatest radio.
A perfect working, single dial control, 7 tube receiver. And just to prove our claims, we will ship it to your home for **30 days' free trial.** Test it under all conditions. Test it for distance, volume and tonal quality — and if you are not convinced that it is the best single dial set you ever heard, return it to the factory. We don't want your money unless you are completely satisfied.

BIG PROFITS TO AGENTS AND DEALERS
Our Agents and Dealers make big money selling Metrodyne Sets. You can work all or part time. Demonstrate the superiority of Metrodynes right in your home. Metrodyne Radios have no competition. Lowest wholesale prices. Demonstrating set on 30 days' free trial. Greatest money-making opportunity. Send coupon below—or a letter—for our agent's proposition.

Metrodyne Super-Seven Radio

A single dial control, 7 tube, tuned radio frequency set. Approved by America's leading radio engineers. Designed and built by radio experts. Only the highest quality low loss parts are used. Magnificent, two-tone walnut cabinet. Artistically gilded genuine Bakelite panel, nickeled piano hinge and cover support. All exposed metal parts are beautifully finished in 24-k gold.

Easiest set to operate. Only one small knob tunes in all stations. The dial is electrically lighted so that you can log stations in the dark. The volume control regulates the reception from a faint whisper to thunderous volume, 1,000 to 3,000 miles on loud speaker! The Metrodyne Super-Seven is a beautiful and efficient receiver, and we are so sure that you will be delighted with it, that we make this liberal **30 days' free trial offer.** You to be the judge.



30 Days' FREE Trial

6 Tube Set $48.50 RETAIL PRICE *Completely Assembled*

Metrodyne Super-Six

Another triumph in radio. Here's the new 1927 model Metrodyne 6 tube long distance tuned radio frequency receiving set. Approved by leading radio engineers of America. Highest grade low loss parts, completely assembled in a beautiful walnut cabinet. Easy to operate. Dials easily logged. Tune in your favorite station instantly on same dial readings every time. No guessing.

Mr. Howard, of Chicago, said: "While five Chicago broadcasting stations were on the air I tuned in seventeen out-of-town stations, including New York and San Francisco, on my loud speaker horn, very loud and clear, as though they were all in Chicago."

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal **30 days' free trial offer,** which gives you the opportunity of trying before buying.

MAIL THIS COUPON
or send a postal or letter. Get our proposition before buying a radio. Deal direct with manufacturer—**Save Money.**

Mail COUPON Below!

Let us send you proof of Metrodyne quality

F. L. Warnock, Greentown, Ind., writes: "I received the Metrodyne in good shape and am more than pleased with it. Got stations 2,000 miles away."

C. J. Walker, Mariposa, Calif., writes: "Received my Metrodyne Single Dial set O. K. I believe that these one-dial sets are going to be excellent sellers. I had no trouble in tuning in stations enough to satisfy anyone, so you will please send me another set."

Roy Bloch, San Francisco, Calif., writes: "Very often we travel from New York to the Hawaiian Islands quickly — from station to station — by means of the little tuning-knob which operates the electrically-lighted dial. The Metrodyne Single Dial Set is much easier to operate than any radio set I've ever seen."

We will send you hundreds of similar letters from owners who acclaim the Metrodyne as the greatest radio set in the world. A postal, letter or the coupon brings complete information, testimonials, wholesale prices, and our liberal **30 days' free trial offer.**

METRO ELECTRIC COMPANY
2161-71 N. California Ave., Dept. 109
Chicago, Illinois

Gentlemen:

Send me full particulars about Metrodyne 6 tube and 7 tube sets and your **30 days' free trial offer**

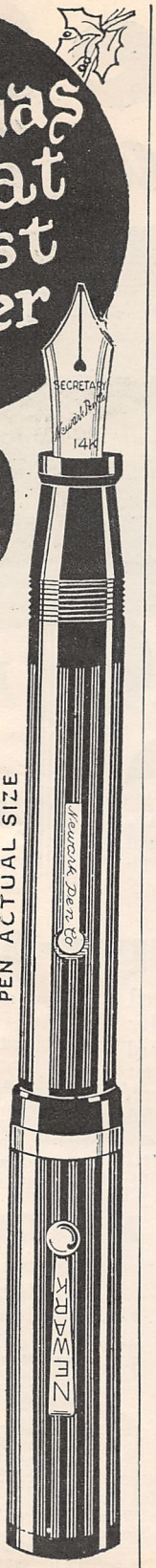
*Name*_____

*Address*_____

If you are interested in AGENT'S proposition, place an "X" in the square ➡ ☐

METRO ELECTRIC COMPANY
2161-71 N. California Ave. • Dept. 109 • Chicago, Illinois

A Christmas Gift that will last forever



Only $2.50

for this handsome pen — positively the equal of any at $8.50.

Unconditionally Guaranteed

First cost is last cost. Never will you be charged for any repairs, regardless if the Newark Pen is broken through accident or misuse. Never another cent of cost.

Lasts a Lifetime

The nib is made of 14-kt. gold, tipped with the best grade of hard iridium which can't wear out. Nothing can affect the super-smooth writing point. Glides over the roughest paper—yet can make 4 carbon copies. Truly a manifold pen!

Has a hand-turned barrel, cardinal red or flashing black, artistically chased. Heavy, 14kt. gold filled mountings. A pure gum sack of large ink capacity. Never-clogging; never-leaking. In every sense the equal of any $8.50 pen at a price which is *less than a storekeeper's profit on such a pen.* Made by experts with 25 years' experience and sold O N L Y by mail—from Maker to You.

FREE Premium

Send no money. Just mail the coupon below. You will receive a Newark Pen and 5 premium cards, each worth 50c on the purchase of another pen. You can give them away if you wish. But you can easily dispose of these cards at 50c each. YOUR PEN WILL THEN COST YOU NOTHING.

Your choice of men's or women's models. They make ideal and useful gifts that compliment both the giver and the recipient. Show it to friends—write with it for 5 days—you'll be surprised and delighted, or we'll refund your money.

Send No Money—Mail This!
5 Days Free Trial

Newark Pen Co.,
276 N. J. R. R. Ave., Newark, N. J.

Please send me via Parcels Post collect, a Newark Pen and five premium cards which I may dispose of at 50c each. I will pay the postman $2.50 plus postage, and if I am not satisfied after five days use, you guarantee to refund my money

X indicates my choice: Men's.... Women's.... Red....

Black..... Medium Nib..... Fine Nib.....

Coarse Nib.....

Name .....

Address .....

Town RN-12

A Universal All-Circuit Set

(*Continued from page 665*)

sections, one single .00038-mf. (17-plate) variable condenser, C4, one midget balancing condenser, C5, for use as a vernier, and two automatic filament controls, R4.

As shown in the illustrations, (Figs. 5, 6, and 7) when the back of the panel is toward you, the midget condenser, C5, is mounted in the top center hole, with its terminals toward your left. Directly below it is the switch, S. The 20-ohm rheostat, R, is about midway between these two instruments and a little toward their right, the 10-ohm rheostat, R1, to their left. The terminals of both rheostats should point toward the center of the panel. At the ex-

(*Continued on page 765*)

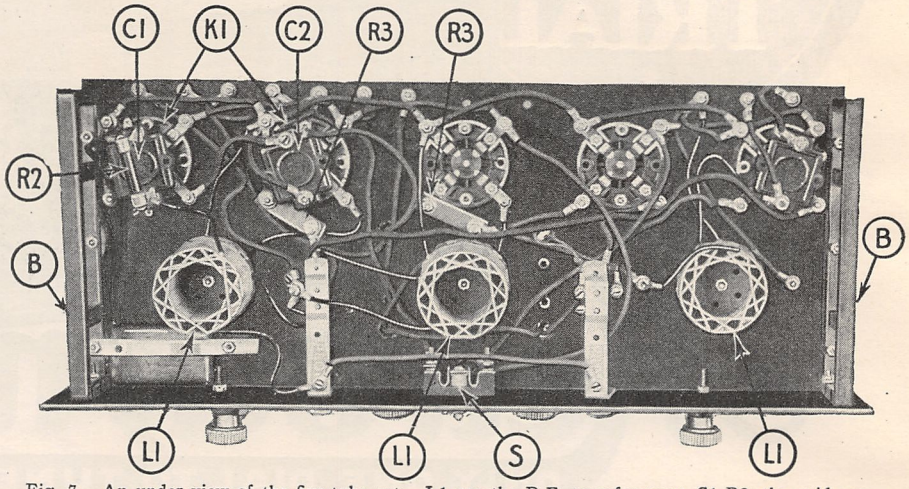


Fig. 7. An under view of the five-tube set. L1 are the R.F. transformers; C1-R2, the grid condenser and leak; C2, a by-pass condenser; R3, the stabilizing resistances; K1, the R.F. tube sockets; and S, the filament switch.

SYMBOL	Quantity	NAME OF PART	VALUE OF PART	REMARKS	MANUFACTURER★	
C	1	Var. Cond.	.0005 mf	23 Plate	1	10,5,11,32
L	1	Coupler	200-600 m	3 circuit tuner	3	4,5
T	2	Audio Trans.	3½ to 1		2	6,7,36,8
P	1	Panel		7X18X1/8 inches	1	9,24,25
SP	1	Sub-Panel		7X17X1/8 inches	1	9,24,25
A	1	Cabinet		7X18X7 inches	1	26,27,28
B	2	Brackets		2 inch	1	9,29,5
D	2	Dials		Vernier	1	10,12,15,7
BP	9	Binding Posts			1	13,14,5
K	3	Sockets		Universial Type	1	6,10,15,16,7
J1	1	Jack		4 pt. filament control	1	10,17,18,19
J	1	Jack		3 pt. open circuit	1	10,17,18,19
S	1	Switch		Filament	1	18,20,30
C1	1	Grid Cond.	.00025 mf		1	21,22,23,31
R	1	Rheostat	10 ohm	With dial	1	11,15,17,20,31
R1	1	Rheostat	20 ohm	With dial	1	11,15,17,20,31
G	1	Pilot Light			1	5
C2	1	Fixed Cond.	.002 mf	Detector By-pass	1	21,22,23,31
R2	1	Grid Leak	2 meg.		1	31,23

TO MAKE THE 5 TUBE RECEIVER, OMIT C AND L AND ADD THE FOLLOWING PARTS. THE PANEL AND SUB-BASE DRILLING REMAINS THE SAME.

R4	2	Auto.Fil.Control			33	34,35
C4	1	Var. Cond.	.00038 mf	17 plate	1	5,10,11,32,7
C3	1	Var. Cond.	.00038 mf	Tandem 17 plates each	1	5,10,11,32,7
L1	3	R.F. Trans.		To Match Condenser	3	4,5,7
K1	2	Sockets		Universal Type	1	6,10,15,16,7
R3	2	Var. Dampers	700 ohm	(Special)	1	
C5	1	Var. Cond.	.000025 mf	7 plate compensating	1	10,32
C6	1	Fixed Cond.	.006 mf	Bypass	1	21,22,23,31
C7	1	Fixed Cond.	.5 mf	Alternate for above (Bypass)	1	21,22,23,31

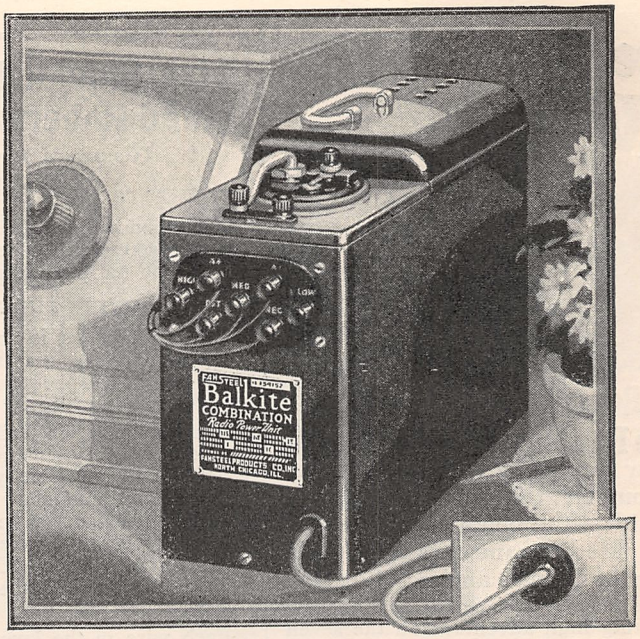
NUMBERS IN LAST COLUMN REFER TO CODE NUMBERS BELOW.

1 Pilot Elec. Mfg. Co. Inc.	17 H. H. Frost, Inc.	33 Radiall Co.
2 Dongan Elec. Mfg. Co.	18 Saturn Mfg. & Sales Co.	34 Langbein-Kaufmann Radio Co.
3 Twin Coupler Co.	19 Millimeter Mach. Wks., Inc.	35 Daven Radio Corp.
4 Ambassador Sales Co.,	20 Cutler-Hammer Mfg. Co.	36 Samson Electric Co.
5 Bruno Radio Corp.	21 Sangamo Elec. Co.	37
6 General Radio Co.	22 Dubilier Cond. & Radio Co.	38
7 All American Radio Corp.	23 Aerovox Wireless Corp.	39
8 Thordarson Elec. Mfg. Co.	24 Pausin Engineering Co.	40
9 American Hard Rubber Co.	25 General Insulate Co.	41
10 Pacent Elec. Co., Inc.	26 Electrotype B'lking. Co.	42
11 DeJur Prods. Co.	27 Southern Toy Co.	43
12 Mar-Co Co.	28 Corbett Cabinet Co.	44
13 H. H. Eby Mfg. Co.	29 A. D. Cardwell Mfg. Co.	45
14 X-L Radio Labs.	30 Carter Radio Co.	46
15 Amsco Prods. Inc.	31 Polymet Mfg. Corp.	47
16 Benjamin Elec. Mfg. Co.	32 Hammarlund Mfg. Co.	48

APPROXIMATE COST OF PARTS $ 25.00 for 5 tube set
22.00 for 3 tube set

Form Copyright 1926 E. P. Co.

★THE FIGURES IN THE FIRST COLUMN OF MANUFACTURERS INDICATE THE MAKERS OF THE PARTS USED IN THE ORIGINAL EQUIPMENT DESCRIBED HERE.



The new Balkite Combination *supplies all radio power automatically from the light socket*

A New Balkite "B" at $27.50

Eliminates "B" batteries and supplies "B" current from the light socket. Three new models. Balkite "B"-W at $27.50 for sets of 5 tubes or less requiring 67 to 90 volts. Balkite "B"-X for sets of 8 tubes or less; capacity 30 milliamperes at 135 volts —$42. Balkite "B"-Y for any radio set; capacity 40 milliamperes at 150 volts — $69. (In Canada: "B"-W $39; "B"-X $59.50; "B"-Y $96.)

The New Balkite Charger

MODEL J. Has two rates. A low trickle charge rate and a high rate for rapid charging. Can thus be used either as a trickle or as a high rate charger. Noiseless. Rates: with 6-volt battery, 2.5 and .5 amperes; with 4-volt battery, .8 and .2 ampere. Price $19.50. West of Rockies $20. (In Canada $27.50.)

Balkite Trickle Charger, $10

MODEL K. With 6-volt "A" batteries can be left on continuous charge thus automatically keeping the battery at full power. With 4-volt batteries can be used as an intermittent charger. Or as a trickle charger if a resistance is added. Rate .5 ampere. Price $10. West of Rockies $10.50. (In Canada $15.)

All Balkite Units operate from 110-120 volt, 50-60 cycle AC, except the Balkite Charger which is also made in 25-40 cycle model.

Now you can operate your radio set from the light socket. Merely by adding the new Balkite Combination Radio Power Unit. Once connected to your "A" battery and set and plugged into the light socket, it *supplies automatic power to both circuits.* You need not even turn it off and on, for it is controlled by the filament switch already on your set and is entirely automatic in operation. Whenever you turn on your set you will find it always ready to operate with full even silent power. It will give you a constant quality of reception that cannot be secured in any other way.

Balkite Combination can be installed in a few minutes, either near the set or in a remote location.

Like all Balkite Radio Power Units it has no tubes, nothing to replace or renew, is a permanent piece of equipment, and is built to conform with the standards of the Underwriters' Laboratories. It is noiseless in operation. It will serve any set now using either 4 or 6-volt "A" batteries and requiring up to 30 milliamperes at 135 volts of "B" current — any set of 8 tubes or less, including power tubes.

Add Balkite Combination to your radio set and convert it into a light socket receiver. Know the pleasure and convenience of owning a set always ready to operate at full power. Price $59.50. [$83 in Canada.] Ask your dealer. *Fansteel Products Co., Inc., North Chicago, Ill.*

The Balkite
Radio Symphony Concerts
with WALTER DAMROSCH
and the New York Symphony

These concerts are broadcast every other Saturday Evening. On intervening Saturdays Mr. Damrosch gives a piano recital on the Wagner Music Dramas. At 9 P. M. Eastern Standard Time, over a group of 12 stations: WEAF, WEEI, WGR, WFI, WCAE, WSAI, WTAM, WWJ, WGN, WCCO, KSD, WDAF.

FANSTEEL

Balkite *Radio Power Units*

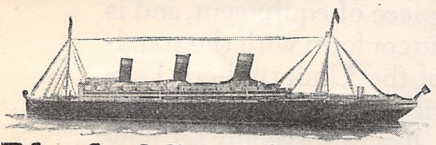
See the World FREE!

Taste Romance and Adventure In the Far Lands of the Earth

How often you've longed to see for yourself the awe of Egypt's pyramids—the beauties of the gorgeous Mediterranean sunset—the squalor of China's ancient cities!

Spend a few years, or the rest of your life, tasting high adventure on the seven seas and in all the world's great ports—roving the earth's highways and byways! You can do it FREE—all your expenses paid—and earn a good salary besides!

Only one profession will carry you around the world at will, travelling like a gentleman, but that's the most interesting and pleasant work there is—Radio Operating! Easily and quickly learned, there's no other profession like it for the man who wants the experiences and pleasures of world-travel. Radio operators are needed—all sea-going ships like the one shown here must carry from one to half a dozen or more.



Take a Look Beyond the Skyline Without a Penny's Expense

Radio operators aboard ocean liners live luxuriously—they rank as officers of the ship. Meals, a private cabin, all other living needs are furnished free, and besides the operator draws a good salary. You can learn quickly and easily at home in your spare time to be a Radio operator through our practical training methods. Take a look at the FREE BOOK which tells how—mail coupon below.

This U. S. Government-recognized school has been training successful operators since 1914. Our graduates are all over the world. We maintain an Employment Department to put you on your own ship. The world-famous NATROMETER, our own patented invention, obtainable only by students of this institute, is recognized as the best and easiest way to learn the Radio code. A few short months, with the aid of the famous Natrometer and our quick home training, and you too can be a fully qualified Radio operator, sitting in your cabin like the one shown above, bound out for Liverpool or Nagasaki!

Read the Free Book that tells all about this fascinating profession and our practical Government-recognized methods of training you for it. Send coupon TODAY—no obligation. Special tuition offer now on for limited time includes world-famous Natrometer free of extra cost with your course. Act at once.

NATIONAL RADIO INSTITUTE
WASHINGTON, D. C.

SPECIAL OFFER COUPON

National Radio Institute,
Dept. P W-11, Washington, D.C.

Gentlemen: Without obligating me in any way send me your free book and information about your special limited Natrometer offer.

World-Famous Natrometer

Name .....

Address .....

The Shielded Hammarlund-Roberts Receiver

(*Continued from page 654*)

Now mount the middle variable condenser and the front wall of the shield on the front panel, with flat-head screws.

WIRING THE R.F. UNIT

Although the set is not as yet completely assembled, we can now start wiring the R.F. unit; as it will be easier than after the shields are assembled.

The designers, in building the set, have planned a very systematic scheme of wiring, which if followed exactly, will insure accuracy with a minimum amount of labor. Spaghetti-insulated wire is recommended, especially where the wires pass hrough holes in the metal shields. Use a hot soldering iron cleaned and tinned, with resin-core solder.

Each wire in the layout, Fig. 6, is numbered. After a wire is placed in the set, cross it off the layout, Fig. 6, with a heavy pencil; after all are crossed off, the set is complete. Solder each end of each wire to the terminals indicated in the layout.

First, install wires 1 and 2. Then mount the equalizer condenser, C1, on the grid terminal of the second socket, S; after which the side walls of the shield nearest the panel may be assembled.

Then fasten connections 3, 4, 5 and 6. Wires 5 and 6 support the resistance R. Holes are provided in the shields where the wires pass. Then install wire 7 and condenser C1 on the grid terminal of the first socket.

Two terminals are provided for both rotor and stator plates of the variable condensers C. In making connections to the condensers use the nearest terminal. In the layout only one terminal for each set of plates shows, the other being directly under the first.

Now mount the first two R.F. coils, L, L1, to their respective condensers, and install wires 8, 9, 10, 11, 12, 13, 14 and 15. Wire 9 is connected to three terminals, as shown.

The remaining variable condenser, C, may now be mounted on the extension shaft and the two adjacent sides of the shields. Use three ½-inch 6/32 round-head screws for fastening the shields together and mounting the condenser.

Now install wire 16 and then mount the third R.F. coil. Wires 17, 18 and 19 may now be soldered in place. Then mount the midget condenser, C3, to the side of the shield as shown, using the spacer (washer) provided with it. Wires 20, 21 and 22 and the back wall of the shield may now be assembled in place.

This practically completes the wiring of the radio-frequency and detector tubes, with the exception of the connections which will have to be made between these units and some of the terminals of the audio unit and battery binding posts. You will notice

LIST OF PARTS

SYMBOL	Quantity	NAME OF PART	VALUE OF PART	REMARKS	MANUFACTURER★	
RS	1	Combined Fil. Switch & Rheostat	10 ohm		1	12,16,21
J	1	Jack		Single Circuit	1	11,12
C	3	Variable Cond.	.00035 Mf.	Combined with L, L1	2	
R	1	Fixed Resistance	2 ohms	For R. F. Tubes	2	13,14
S	3	Socket		UX Type with Base	3	6,15,16
C1	2	Equalizing Cond.		For Neutralizing	2	16,11,9
L,L1	3	R.F. Transformer		Combined with C	2	
C2	1	Fixed Condenser	.00025 Mf.	With Grid Leak Clips	4	13,16,25
R1	1	Grid Leak	2 meg.		5	18,13,19
C3	1	Midget Cond.	32 Mmf.		2	16,9,11
SW	1	Aerial Switch		S. P. D. T.	1	9,20,21
BP	10	Binding Post			6	16,23
R2	1	Auto.Fil.Control	1/2 Amp.	For power tube	7	19,23
R3	2	Auto.Fil.Control	1/4 Amp.		7	19,23
T	2	Audio Trans.	3-1 Ratio		8	16,11,24
C4	1	Fixed Condenser	.001 Mf.	Bypass	4	13,17,25
D	2	Dials		Vernier	9	8,6,26
S1	2	Sockets		UX Type without base	3	6,15,16
P	1	Panel	7X21X1/8"		2	27,28
SP	1	Sub-Panel	4¼X11¾X1/8		2	27,28
SH	2	Shield	7X6X6"	Complete with lids	2	
ES	1	Extension Shaft		Special	2	
BB	1	Base Board	12X21X1/2	Wood Furnished with Cabinet	32	Or home made
V	4	Vacuum Tube		201A type	10	29,30,31
V1	1	Vacuum Tube		Power for last stage	10	29,30,31
SB	1	Shield Plate	2"X3"	For Ant. Condenser	2	Or home made
M	2	Metal Strip	12X1½X1/8"	Support for Shields	2	Or home made
	1	Cabinet		For 7X21 Panel	32	33

NUMBERS IN LAST COLUMN REFER TO CODE NUMBERS BELOW.

1 Carter Radio Co.	17 Micamold Radio Corp.	33 Ebco Cabinet Co.
2 Hammarlund Mfg. Co.	18 Arthur H. Lynch, Inc.	34
3 Benjamin Elec. Mfg. Co.	19 Daven Radio Corp.	35
4 Sangamo Elec. Co.	20 Yaxley Mfg. Co.	36
5 International Resis. Co.	21 Cutler-Hammer Mfg. Co.	37
6 H. H. Eby Mfg. Co.	22 X-L Radio Lab.	38
7 Radiall Co.,	23 Langbein-Kaufman Co.	39
8 Samson Elec. Co.	24 All American Radio Co.	40
9 The Mar-Co Co.	25 Dubilier Cond. & Radio Co.	41
10 E. T. Cunningham, Inc.	26 Kurz Kasch Co.	42
11 Pacent Electric Co.	27 Insulating Co. of America	43
12 H. H. Frost, Inc.	28 American Hard Rubber Co.	44
13 Electrad, Inc.	29 Radio Corp. of America	45
14 Ward Leonard Elec. Co.	30 Ken-Rad Corp.	46
15 Alden Mfg. Co.,	31 DeForest Radio Tel. & Tel. Co.	47
16 General Radio Co.	32 Baker Yacht Basin, Inc.	48

APPROXIMATE COST OF PARTS $ 95.00

Form Copyright 1926 E. P. Co.

★THE FIGURES IN THE FIRST COLUMN OF MANUFACTURERS INDICATE THE MAKERS OF THE PARTS USED IN THE ORIGINAL EQUIPMENT DESCRIBED HERE.

Eveready's exclusive Layerbilt construction *makes this the most economical of* "B" *batteries*

IMPROVEMENT on top of improvement has been the history of Eveready Radio Batteries. Here, in the radically different Eveready Layerbilt, is the "B" battery which tops them all. The ability of this battery to give you unrivaled service and economy is due to its unique internal design. Instead of the usual assembly of round cells, it is built of *flat* layers of current-producing materials pressed firmly together. This construction makes use of the spaces now wasted between the round-type cells and avoids the usual soldered wire connections. Eveready Layerbilt is every inch a battery. This exclusive Eveready Battery development packs more active chemicals in a given space and enables them to produce more current and give longer life.

Tuesday night means Eveready Hour—9 P. M., Eastern Standard Time, through the following stations:

WEAF—*New York*	WTAM—*Cleveland*
WJAR—*Providence*	WWJ—*Detroit*
WEEI—*Boston*	WGN—*Chicago*
WTAG—*Worcester*	WOC—*Davenport*
WFI—*Philadelphia*	WCCO—*Minneapolis* / *St. Paul*
WGR—*Buffalo*	
WCAE—*Pittsburgh*	KSD—*St. Louis*
WSAI—*Cincinnati*	WRC—*Washington*

EVEREADY
Radio Batteries
-they last longer

This HEAVY-DUTY EVEREADY LAYERBILT BATTERY gives twice the service of the smaller Light-Duty batteries and greatly reduces your "B" battery operating cost.

Use Eveready Layerbilts on any set, and get not only this extra service, but also—the greatest "B" power operating economy—the utmost in "B" power dependability—D. C. (direct current) in its purest form, so necessary for pure tone quality. There is an Eveready dealer nearby.

Manufactured and guaranteed by
NATIONAL CARBON CO., INC.
New York San Francisco
Canadian National Carbon Co., Limited
Toronto, Ontario

SAIL AWAY
AS A
RADIO OPERATOR

TRAVEL to foreign shores as a radio operator and draw good pay while you see the world.

Radio operating is fascinating work. Excellent quarters and board, the ranking of a ship's officer, and shore leave in foreign ports are among the privileges accorded to the "op". The prominent radio positions held by our 8,000 graduates show the wonderful opportunities for advancement.

• • •

RIA conducted by RCA

Radio Institute of America instruction is not surpassed anywhere. The Institute is conducted by RCA and, in addition to enjoying every advantage of the world's greatest radio organization, it has seventeen years' experience back of it.

• • •

Study at home

A few months of study at home will qualify you to pass the U. S. Government Commercial Amateur or Broadcast License Examination and start on a successful radio career.

Send in the coupon. It will bring you a booklet filled with interesting information on license requirements and opportunities in the radio field. It outlines our courses in detail.

• • •

Radio Institute conducts a special technicians' course for radio dealers, jobbers and service men. Write for information.

Send this in

Radio Institute of America
324 Broadway, New York City
Please send me your free booklet.
☐ I am interested in the radio course which prepares for the Govt. Commercial, Broadcast or Amateur License.
☐ I am interested in the technicians' course for jobbers, dealers and service men.

Name _____

Address _____

Radio Institute of America
324 Broadway - New York City

that there are very few connections; this is due to the fact that many are automatically made when the parts are mounted on the shield.

WIRING THE AUDIO UNIT

You can now proceed to assemble and wire the audio unit. A very good view of the bottom of the audio unit is given in Fig. 4, which shows the location and placing of soldering lugs to which connections are made.

Next mount the two sockets, S1, placing the springs on the bottom side of the sub-panel and the tube supports on the top side of the sub-panel. The two portions of the socket are disassembled by unscrewing the screw at the center. Be sure that the springs are not bent, or twisted; and in mounting the sockets be careful to assemble them so that the two halves fit together properly. As an additional check on the positions of the terminals, make sure that the arrow on the socket is in the same position as shown in Fig. 6.

Next mount the two audio transformers, T,T, with their terminals in the positions as shown in Fig. 6. The location of the terminals is very important. In mounting the transformers use four 3/8-inch 6/32 round-head machine screws, two for each instrument. The other mounting holes will be used later for mounting the unit on the baseboard.

A simple way to mount the automatic filament controls, R2, R3, so that the terminals will be on the under side of the sub-panel, is to disassemble the clips and then use ½-inch 4/36 round-head machine screws to fasten the mountings to the sub-panel, with the screws projecting on its bottom side. Soldering lugs can be fastened in place on the under side of the sub-panel, making the connection with the terminals of R2, R3.

Next mount the binding posts in the order shown in Figs. 1 and 6. The soldering lugs should be placed on the bottom side of the sub-panel, except for that on the "A Bat. +" binding post, which should be placed on the top side instead.

Although all the connections are shown in the same style in the layout, you will note from the photographic illustrations that practically all the wiring of the audio unit is placed underneath the sub-panel. Therefore this unit is almost completely wired by itself before installing in the set.

Begin by soldering in place wires 23, 24, 25, 26, 27 and 48. Be sure that none of the connections on the underside of the sub-panel is close enough to interfere with the action of the spring sockets. Where it is necessary to cross over the sockets the wires should be carried at least a quarter of an inch away from the socket springs.

Now connect in turn wires 28, 29, 30, 31, 32, 33, 34 and 35. This completes the preliminary wiring of the audio unit.

You can now mount the audio unit on the baseboard as shown in Fig. 3 and make the final connections between the audio terminals and the rest of the receiver.

In mounting the unit, use the remaining holes in the transformers, through which should be threaded 1½-inch No. 6 round-head wood screws. The unit should be mounted as shown, with a space of ¼-inch between the edge of the unit sub-panel and the shields on the one side, and 1½ inches between the front edge of the sub-panel and the front panel of the receiver.

Now connect in turn wires 36, 37, 38, 39, 40, 41, 42, 43 and 44. The by-pass condenser, C4, may now be connected to the socket terminals with wires 46 and 47. One more wire, 45, which connects the frame of the first variable condenser with the shield, completes the wiring.

PLACING THE SET IN OPERATION

If you have followed the wiring instruc-

Complete Parts for the ULTRADYNE
MODEL L-2

The Ultradyne is the only receiver that incorporates the "Modulation System" of radio reception. The most selective set known—capable of detecting the faintest broadcast signals, making them audible on the loud speaker. A real distance getter. Fully described in our free circular.

Hammarlund ROBERTS HiQ

The easiest receiver on the market to assemble. Designed and backed by the leading radio manufacturers. Every part synchronizes the most efficient 5-tube receiver.

LC-27

Such a demand is expected for parts to build the LC-27 that we have made special arrangements to stock these complete parts in large quantities. Immediate shipment is assured if you order from us.

Madison Guarantee

Madison offers the most unusual guarantee of any house in the radio industry. If complete parts to build receivers shown in our circular are ordered from us, we guarantee the receiver after you assemble it, to function as we claim. If not, we make it do so at no cost to you.

Dealers Send for Circular

Send for free circular. Shows the most complete line of nationally known radio parts and accessories.

Madison Radio Corporation,
114-C East 28th St., New York City.
Please send me immediately a copy of your free circular showing how I can save money on standard radio parts.

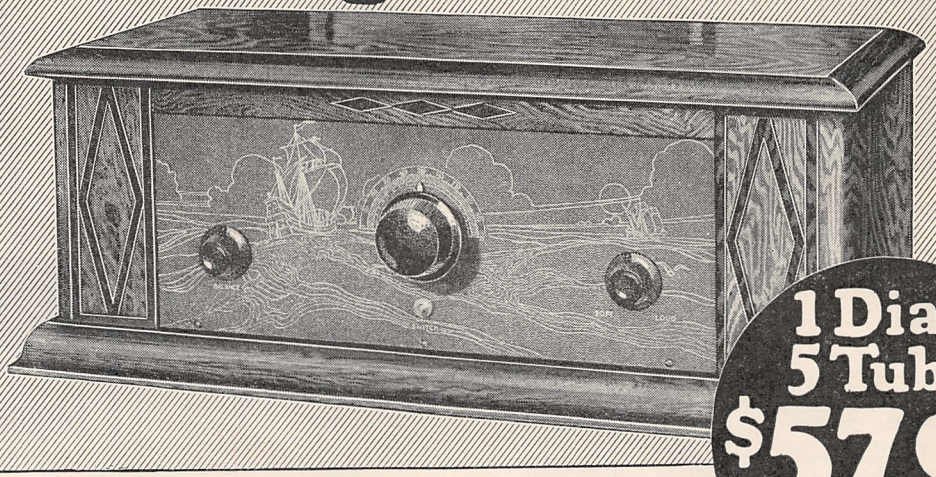
Name .....

Address .....

.....

30 Days Trial

Only ONE Dial to Tune



1 Dial 5 Tube $57.00 RETAIL PRICE

THE LAST WORD IN RADIO--- and the biggest values ever offered

Yes Sir!—you can put a NEW 1927 Model Westingale, 5-tube Radio in your own home and use it to your heart's content on 30 DAYS' TRIAL. Entertain your family and friends. Listen to the music, concerts, sports, news, market reports from stations all over the country. Compare it with other sets for beautiful appearance—wonderful performance and low price—and if you are not convinced that Westingale gives you the greatest measure of Radio satisfaction and the best value for the money—YOU DON'T HAVE TO KEEP IT.

Westingale Sets Have Been Tested and Approved by Popular Science Institute, Farm Mechanics Radio Dept.

POWERFUL-- DEPENDABLE **WESTINGALE** 5-TUBE-- COAST TO COAST

Don't buy any Radio until you send the coupon below for our FREE Catalog which pictures and describes both the new 1-Dial and 2-Dial Models. Why pay more? Why not get the NEWEST Radio? Why take chances when all we ask is a 30-Day Trial at our risk to convince you that these NEW 1927 Westingale Models are years ahead in powerful reception—wonderful loud clear tone—handsome appearance—and EASY, simple control.

Look at these two distinctive Westingale Models—they're the last word in every way. Every late feature—every new worth while idea is embodied in their make up. Newest style period type cabinets. Two-tone, hand rubbed Walnut finish. The front panels enhanced with an artistic Spanish Galleon design embossed in dull gold, these new Westingale Models are unsurpassed in appearance—unbeatable in performance—and unbeatable in price.

Agents Wanted Everywhere---Buy at Cost

Right now we want to appoint an agent or dealer and place one demonstrating set in each locality because we know that each demonstration will sell more sets. This is your chance to get a Westingale Radio at a big discount and make it pay you big money. For a limited time we offer a big reduction, way below retail prices on the FIRST Westingale outfit placed in each locality. Anyone can make quick sales and big profits in taking orders for Westingale sets. No radio experience necessary. We show you how. $50 to $100 a week—full or spare time. Our FREE book tells all about it.

YOUR OWN RADIO -- *FREE*

2 Dial 5 Tube $47.00 RETAIL PRICE

Special Discount Way Below Retail Prices To Agents and Dealers

Our FREE Catalog also explains a plan whereby you can put a Westingale Radio in your home on 30 Days' Trial — demonstrate it to your neighbors and friends in your spare time, and get your own set without cost before the trial period is up. Mail the coupon or a post card for our FREE Radio Catalog today. Be first in your locality to get special discount prices and our FREE Radio offer.

Westingale Electric Co.
Dept. 49
1751 Belmont Ave., Chicago

Be First - Mail Now!

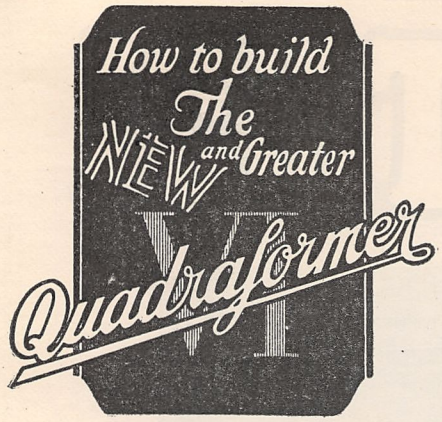
Westingale Electric Co.,
Dept. 49—1751 Belmont Ave.,
Chicago, Ill., U. S. A.

Please send your FREE Catalog on the New 1927 Westingale Radios. Also full particulars of your special Discount on the first outfit placed in each locality and your FREE Radio Offer.

Name .....

Address .....

.....



An Amazing New 6-Tube, Two-Dial Receiver That You Can Easily Build at Home.

The perfect tone reproduction of the new Quadraformer can not begin to be approached by any other receiver—not even former Quadraformer models. But this is not all, for the Quadraformer system of radio frequency amplification accomplishes a combination of radio virtues previously thought impossible in one radio receiver. As Mr. W. G. Hopson (address on request) wrote of the Quadraformer V:

> I am one of those fans looking for tone quality, selectivity and distance, and I have found the three hard to get at the same time, as it has been generally necessary to sacrifice at least one. Recently I built one of your Quadraformers and it surprised me by qualifying in all three. It has a wonderful tone, is very selective, and is a good distance getter. I have traveled from coast to coast and even ventured down into southern Florida. We live in the heart of Chicago and on a recent Saturday night, when the Chicago stations were doing their best I went through them and brought in ten distant stations, including KFI!

NEW FEATURES:
Selective SELECTIVITY and SENSITIVITY

In driving your automobile, you select the gear ratio to suit the need of the moment. If the going is hard, a shift into the powerful low and the car plows right on thru. Second gear is a mixture of power and speed, and high is mostly speed.

The new Quadraformer VI adapts this idea to radio. An arrow knob on the panel has three numbered positions. Set it on "1", and you have maximum selectivity with normal sensitivity. Position "2" is intermediate between selectivity and sensitivity; while "3" gives the set's greatest sensitivity and normal selectivity. For the first time, a radio may be adjusted to work best in any location, and varied from maximum selectivity to maximum sensitivity instantly, at the operator's wish, to suit receiving conditions.

New SHIELDED QUADRAFORMERS

The famous Quadraformer coils have been redesigned and are individually shielded in handsome burnished copper containers. Large wire, specially insulated, is used and the coils are unconditionally guaranteed against burn-outs or other defects. The new shielding makes the set unusually selective, as energy, pick-up by the individual circuits is prevented, and the signal energy you desire to amplify is forced thru each tuned circuit successively.

Efficient HIGH WAVE-LENGTH AMPLIFICATION

Many sets amplify satisfactorily the wave-lengths below 400 meters, but fall down miserably on the higher wave-lengths. In the new Quadraformer VI is incorporated the AMPLITROL—Gearhart Schlueter's latest invention—which absolutely gives you the same powerful amplification on wave-lengths up to, and above, 600 meters, as it does on those around 200. KSD, KFUO, KYW, WHA, WOAW, WNYC and WHO boom in with a volume that is amazing.

Simplicity of Control:

The set is easy to tune—two dials bring in your stations. No verniers. Logs absolutely. It is easy to build. You need only the new Quadraformer Essential Kit, which contains the three shielded Quadraformers, the Amplitrol, the Selectivity Control, and complete instructions, which costs $17.50 prepaid; and some $50 worth of other standard parts, most of which you probably have.

Send 25c. today for the new QUADRAFORMER BOOK, which contains complete step-by-step instructions for building this wonder set.

Gearhart-Schlueter Radio Corpn.
P. O. Box 666A Fresno, California

tions carefully, you will now have the wiring of the receiver completed and ready for testing and adjustment of the equalizer circuits.

The aerial wire should be connected with the center terminal of the aerial switch, SW.

The scheme of connections for the ground and the "A," "B" and "C" batteries is shown clearly in Fig. 6. A good way of making the ground connection is to connect the ground wire directly to the negative terminal of the "A" battery.

Now insert your loud-speaker plug into the jack and you are ready to proceed with the testing and adjustment of the set preparatory to actual operation.

While the selection of the parts that go into the construction of a receiver is important and their proper use essential to efficient operation, you must not lose sight of the fact that the kind of accessories you use with the set will determine in a large measure the degree of efficiency and pleasure you will get from your radio installation.

One of the most important items for efficient operation is that of good tubes. Those mentioned in the list of parts will be sure to give you good results and are therefore recommended. For faithful reproduction you will find it worthwhile to invest in a loud speaker of good characteristics. A good headset should be used for tuning in far distant stations.

A storage battery or power unit will give you a good source of filament current for your receiver. Only the best of dry-cell "B" and "C" batteries or eliminators should be used. "B" battery eliminators are increasing in popularity as a result of the perfection of rectifier tubes. Most of the eliminators which use the Raytheon type of tube will be found satisfactory.

A good aerial installation is absolutely necessary for most efficient operation. Because of the shielding in this set, the outside pick-up is reduced to a minimum. Insulators, wire, lightning arrester, and all the other miscellaneous parts necessary for an antenna installation can be obtained from any radio dealer, as well as the cabinet required.

On page 646 will be found an illustration of the condenser and inductances employed in the radio-frequency amplifier of this receiver.

Q. R. A.'s

J-3QQ. Keikichi Yamaguchi, 18 Nakayamate, 4-chome, Kobe, Japan. (Japanese Amateur Relay League) Will QSL, QRH, QSB, QRK, etc., all cards.

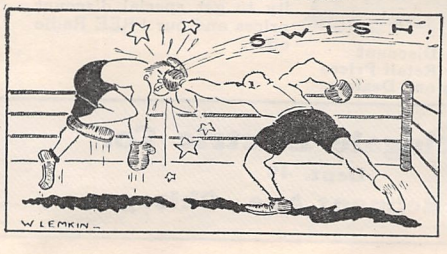
5ADY. Frank Watts, 1716 Park Ave., Shreveport, La., 10 watts Cw, 80, 40-20 meters. Portable station call, 5AMC.

5AKC. D. Bertrand, 318 Marshall St., Shreveport, La. 50 watts Cw, 80, 150 meters.

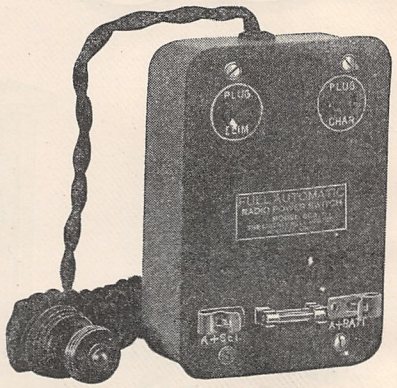
5AUO. Norman C. Willis, DeQueen, Ark., 201A on 40 meters. All cards QSL'd.

5FF. Herschel R. Caler, Springdale, Ark., 20, 40, 80 meters. All cards QSL'd same day as received.

A SOLID CONNECTION



FULL-AUTOMATIC
POWER SWITCH



PATENTS APPLIED FOR List Price **$5**

Forget Your "B" Eliminator

THIS SWITCH AUTOMATICALLY CONTROLS IT

100% AUTOMATIC CONTROL OF "B" ELIMINATOR AND TRICKLE CHARGER

When you snap off your set "FULL AUTOMATIC" turns off your "B" Eliminator for you — and of course when you snap on your set—turns it on again.

The Trickle Charger is also disconnected automatically when you are using your set, and is connected again when you turn the set off. Eliminates the HUM and regulates the charging. This switch can be used for either or both operations.

The Fire Underwriters now require that the "A" Battery circuit of EVERY RADIO SET be protected by a fuse. This feature is built into the FULL-AUTOMATIC switch.

IMPORTANT TO DEALER:
A FULL-AUTOMATIC POWER SWITCH should be installed with every "B" Eliminator sent out on approval to your customers. Should customer forget to turn off the "B" Eliminator, it will burn out the tube or condensers. Not only do you risk this loss, but the experience may discourage your customer from purchasing the "B" Eliminator.
The Full-Automatic switch is 100% Insurance For You

SOLD BY THE BETTER RADIO STORES
Manufactured and Guaranteed by
LIBERTY BELL MFG. CO., Inc.
MINERVA - OHIO

FREE TRIAL

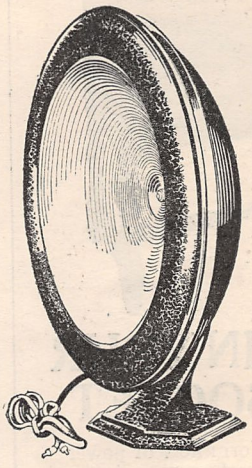
INTRODUCTORY PRICE $24.50

Regular Price:$50.00—Shipped on approval anywhere in the U. S. A. Positively the greatest value in the history of Radio. If after seeing it and trying it out you do not agree, just return it to us. Latest and greatest 5-tube Tuned Radio Frequency Hook-up, licensed by U. S. Navy Dept. Manufactured by us from raw materials—backed by 21 years' experience. Not a "hodge-podge," inefficient assembled job. Volume, distance, tone quality and selectivity that will surprise and delight you.

Agents Send for details of our wonderful franchise and trade-in allowance on old sets. We pay you cash. Write today. Beat the other fellow to it.

PREMIER ELECTRIC COMPANY
827T. Premier Building Estb. 1905 Grace at Ravenswood Chicago, Illinois

Wonderful *new* Loud Speaker



You've *no idea* what a difference the Acme makes!

"I THOUGHT I was getting the best possible reproduction out of my set. But I found I really had *no idea* how clearly it could reproduce music, until I got your new Acme Loud Speaker. It certainly makes a surprising difference..."

The wonderful new Acme Loud Speaker successfully reproduces voices and music in your own home as clearly as they were originally created in the broadcasting studio. It reproduces the voice of the singer in all its thrilling, tender beauty. It brings out the different personality in each voice, so that you can tell one voice from another. It recreates orchestral music so clearly that you can hear each instrument playing. It reproduces low notes and tones as clearly as high notes and tones. You hear the bass and treble, harmony and melody.

All this was not done in a moment, Acme engineers worked five years and made 256 experimental speakers, before they arrived at the new Acme Enclosed Free Edge Cone and Acme Reproducing Unit, which together are responsible for this great increase in radio enjoyment.

Hear this new Acme at your dealer's

TRY OUT this new Acme for yourself. See if all we have said about it is not true. Compare it with others in the dealer's store. Drop in at your dealer's today and hear this remarkable new speaker. Made by Acme Apparatus Co., Pioneer Radio and Transformer Engineers and Manufacturers, Cambridge, Mass., U. S. A. Dept. K-20.

Acme K-3 Enclosed Single Free Edge Cone Speaker, (shown above). Diameter of cone, 11 ins. Green bronze metal case. Price: **$18.50**

Acme K-1 Enclosed Double Free Edge Cone Speaker. Diameter of cone, 14 ins. Tan metal case. Price: **$25.00**

Acme Enclosed Free Edge Cones and Acme Reproducing Units, (Designed for use exclusively with the free edge cone) eliminate resonance and preserve the tones, pure, round and clear. A fixed edge cone, to produce the same results, would have to be three times the diameter, too clumsy for your living-room. High notes are reproduced toward the center of the cone; low notes, toward the edge. The laws of vibration make it possible to produce low notes with a small cone, provided the edge is free and enclosed, and provided the reproducing unit is especially designed for use with a free edge cone.

Write us for circular describing full line of Acme products.

ACME

for amplification

Distantone

"Built By Craftsmen"

PLUG IT IN YOUR LIGHT SOCKET

Continuous and uniform flow of power is supplied from your house current at a cost of less than one-half cent per hour. All Batteries Eliminated. Beautiful duo-tone solid walnut cabinet. Panel control board artistically decorated. Equipped with built-in Amplion speaker of great volume and tone clarity. Ask Your Dealer.

List Price Without Tubes
Model E Console with Power Unit...$275
Model E Console without Power Unit $165

Model F-Single Control Six Tubes. List Price $115

Harmonizes with the furnishings of the richest home! Meets the demands of the most exacting radio enthusiast. The long distance range of this set, its flawless reproduction and the simplicity of its one-dial control, make it one of the biggest radio values. One stage of transformer audio with two stages of Impedance-Coupling in the audio circuit give this model unsurpassed volume and tone. You Must Hear It.

THE DISTANTONE LINE

In addition to the two models shown here, the Distantone line includes five tube receivers of two and three dial control and five and six tube sets with single dial control, all tuned radio frequency.

DISTRIBUTORS
Write or wire us today for the Distantone proposition.

DISTANTONE RADIOS INC.,
Lynbrook, Long Island, N. Y.

Radio Aids Railroading

(*Continued from page* 640)

so-called "hump" or the control point, where the yardmaster maintains his base of operations. Here, between the house of the yardmaster and the pole holding the colored signal lights, was strung the antenna. This corrupted use of the signal towers must have astounded the native citizens of Gibson! The transmitter itself was installed in the house at the "hump." The operation of the transmitter was reduced to utmost simplicity—relays being provided so that the sending set could be placed in action by pushing a button on the microphone handle.

THE PROBLEM OF "SWITCHING"

The conditions under which these pioneer experiments were introduced is best described by P. H. Betts, who designed the receiving set thus used. He tells us:

"To the Gibson yard come freight trains from all directions, made up of cars destined to go to many different places. It is the purpose of the yard to sort out the cars for each destination. The incoming train is shoved up to the top of a hill called the 'hump'; a car or a group of cars is 'cut' from the train and coasts down the other side of the hill into the track appropriate to its destination. The speed of a train of cars up to the hump must be closely regulated, since there must be an appropriate interval between groups or single cars to allow the safe operation of the switches. When there are a large number of cars going to one destination the speed can be greater, because the cars coupled together take less space than single cars. In case of a slip in handling any of the cars it is necessary to correct the error before proceeding with further assortment. All this requires frequent signals from the yardmaster at the 'hump' to the engineman of the pushing locomotive.

"The problem was tackled in the usual railroad method—that of colored signal-lights set from a switchboard at the hump. But it is obvious that if more orders could be indicated, or if individual orders could be given to fit every specific case, the control would be more efficient. Then, too, the climate is such that there is often mist, and this almost obliterates the signals. At best the signals are only dimly visible in good daylight; and in the afternoon, the sun is back of the signal and makes its light almost invisible to the engineman. The distance of the engineman from the hump is, of course, the length of the train his locomotive is pushing, and this may often be as much as a mile. In cases of emergency, when the signal lights are totally obscured, the roundhouse whistle is used. This, of course, is cumbersome, and a better way of communicating with the engineer was sought."

HOW RADIO SIMPLIFIED SIGNALING

The results achieved in using radio as a means of assorting box cars and routing them to their proper destinations are described as follows:

"After the preliminary testing the system was turned over to the yardmaster for practical operation. All that was necessary for him to do was to push the button on the microphone and talk, practically the same procedure as would have been used to talk to any of the towers.

"It was apparent how much more useful the radio system would be than that of signal lights when the yardmaster told the engineman to come ahead with his train at a good speed until the first car had reached the hump. For a while it looked as though he had entirely forgotten that the cars could not be allowed to go over the hump at a speed greater than four miles per hour,

FREE

Our New 1927 100 Page

RADIO CATALOG

BEFORE you build or buy a radio be sure to consult our new 100 page catalog—sent to you free. All the latest kits, accessories, and parts—a million dollar radio stock to choose from.

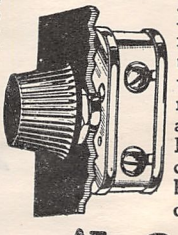
We Save You Money

We handle only brand new apparatus—standard makes that are fully guaranteed. QUANTITY sale of QUALITY parts explains our low prices. Compare with others and see why thousands of fans look to us as radio headquarters. Write for your copy of this new catalog today.

CHICAGO SALVAGE STOCK STORE
509 S. STATE ST., Dept. RN.
CHICAGO, U. S. A.

Bradleystat

PERFECT FILAMENT CONTROL



Provides complete noiseless filament control for all radio tubes without change of connections. Metal parts are nickel plated. One hole mounting. Self contained switch opens battery circuit when desired.

Allen-Bradley Co.
Electric Controlling Apparatus
287 Greenfield Avenue Milwaukee, Wis.

What Really Comes Through Your Transformer?

We know what you want to get out of your set. Everyone wants it. It is clear, pure-toned reception—and you don't want to miss a note from the muffled base of the kettledrum or the profound booming of the baseviol to the shrill "sky-high" tones of the fife and piccolo.

So much depends on your circuit, so much on your speaker—but even more on your transformers. To render sweet music and to get the full range of orchestral or instrumental performance, the transformer must faithfully reproduce all frequencies.

The FERRANTI TRANSFORMER

Meets Every Condition of Good Audio Reception

It takes two and a half miles of wire for the coils of the A.F. 3 and one and a half for the A. F. 4 plus the many refinements which the genius of Dr. Ferranti has made possible, to create transformers whose amplification curve is almost perfect—almost a straight line. By installing Ferrantis you can modernize your old set or perfect your new one. Ferranti will give you an uncensored message from the sending station.

If you want to make the best of the power tube feeding the loud speaker, use Ferranti.

Ask your dealer for a Ferranti. Don't be satisfied until you have installed one. If he does not carry Ferranti Transformers, write us and we shall tell you where you can get one. No better transformer is available at any price.

For the best available transformer results—Ferranti Audio Frequency Transformer A.F. 3—ratio 3½ to 1—$12.

For a transformer far superior to the average, use Ferranti A. F. 4—ratio 3½ to 1—$8.50.

HIGHSPOTS

High amplification ratio with flat curve.

Ferranti brings out the fundamental frequency of low tones—none are heard merely by inference from higher harmonics.

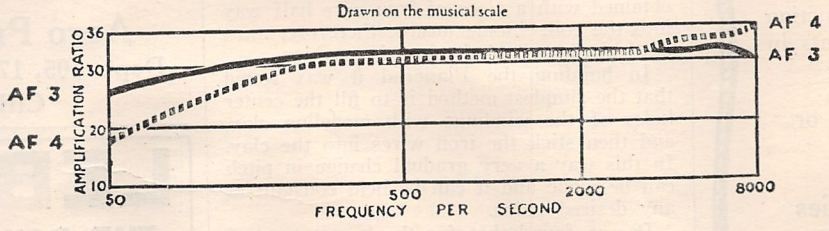
Every transformer tested ten times—all short-circuit turns eliminated.

Windings have high impedence.

Built by an established manufacturing company with forty years' experience in the winding of coils of fine wire for electrical instruments and meters.

Primary shunted with built-in condenser of correct capacity

Tested to 1000 volts between primary and secondary and between primary and secondary and ground.



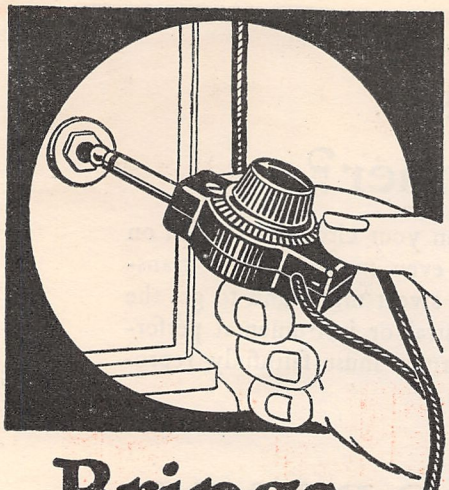
This graph is drawn on a musical scale—the only accurate way of showing the full value of each tone which your set receives. Note that the evenness and fullness of amplification in both the Ferranti A. F. 3 and the A. F. 4 extends throughout the range of the organ, cello and the human voice.

No Better Transformer Is Available at Any Price

FERRANTI, INC.
130 West 42nd Street
New York, N. Y.

No Better Transformer Is Available at Any Price

THE NEARLY PERFECT TRANSFORMER



Brings Your Set Up To Date

The only real advance claimed by the makers of this year's best sets is improvement in tone performance. This improvement can be made in your present set by simply adding the Centralab Modu-Plug. This modernizing device makes your reception equal in tone performance to that of the latest high-priced receivers.

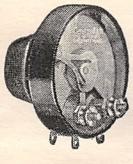
Modu-Plug is warranted by Central Radio Laboratories, makers of variable resistances for sixty-nine manufacturers of leading standard sets.

Centralab Modu-Plug replaces the loud speaker plug. Gives any degree of tone volume from a whisper to maximum by simply turning the small knob on the plug, without adjustments of other controls. Modu-Plug matches the speaker impedance to the output impedance of the set. Reduces interfering noises. Clarity and faithful reproduction equal the latest developments in perfected performance.

$2.50 at your dealer's, or mailed direct, C.O.D.

Central Radio Laboratories
19 Keefe Ave., Milwaukee, Wis.

Canadian Representative—Irving W. Levine, Montreal.
Australian Representative—United Distributors, Ltd., Sydney.
Great Britain Representative—R. A. Rothermel, Ltd., London.



Centralab Radiohm permits clear, true-tone reception by holding the sensitive regenerative position which immediately precedes the oscillation point, without distortion or loss of selectivity. A standard unit on leading sets. Retail price, $2.00, at your dealer's or from us C.O.D.

Centralab CRL

as the train was approaching at a speed very close to ten miles per hour. One of the car inspectors reminded the yardmaster of this, and the latter made a wild grab for the microphone and shouted 'Slow down to two miles an hour.' The engineman had been expecting some such order, and immediately slowed the train down as directed. The best that could have been done with the signal lights would have been to instruct the engineman to come ahead at four miles an hour until ordered to slow down.

"Very often new ideas meet with a lack of sympathy, and consequently fail to accomplish their purpose. This was not the fate of the radio system, for it met with enthusiastic recognition by all, who were in touch with its operation. Inasmuch as no commercial installation has been made, and as the first demonstrations lasted but two days, no definite data can be advanced to show how much operation can be speeded up by the use of the radio telephone system. The railway engineers, who were present during the tests, were enthusiastic, and it may very well be that this small beginning may mean the introduction of radio telephony to the railway field."

How to Build a Pianorad

(*Continued from page* 655)

nections is to try one way and then the other; the speaker will give out a loud squeal when the connections are correct.

TUNING THE PIANORAD

Now we come to the problem of controlling this squeal, and making a musical tone out of it. First we connect a fixed condenser (C)) across the secondary winding as shown; immediately the squeal becomes much *lower* in pitch. By connecting condensers of different capacities across this winding, the pitch of the squeal will be correspondingly varied. The larger the condenser, the lower the pitch, and vice versa.

It is almost impossible to obtain fixed condensers of the exact capacities required to tune the circuit to a definite musical tone. Therefore, we connect across the coil a fixed condenser that gives a note rather near, but *higher* in pitch than the musical tone required; and then fine iron wires, or for that matter any small pieces of iron such as nails, are placed in the center of the windings, where the core was originally. As the iron approaches the coil the pitch of the tone lowers. Perhaps the correct note is obtained with a piece of iron wire half way into the coil. Some means, therefore, must be devised to hold the iron in position.

In building the Pianorad it was found that the simplest method is to fill the center holes of the windings with modeling clay, and then stick the iron wires into the clay. In this way a very gradual change in pitch can be made and it can be held constant at any desired value.

It was found that for the lowest tone of the Pianorad, which is one octave below middle C, or a frequency of 128 cycles per second, a fixed condenser of .02-μf. capacity was required. For the highest note, one octave above middle C, or a frequency of 512 cycles, no condenser was required. A few pieces of iron wire in the core were sufficient to lower the pitch to the desired value.

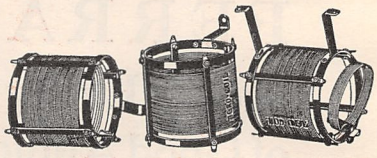
This *audio oscillator* of Fig. 1 will be found useful in the experimenter's laboratory for other purposes than that of generating musical tones. It may be used for testing loud-speakers, transformers, and other radio apparatus.

Instead of connecting the loud-speaker directly in the plate circuit of the vacuum

Greater Distance Finer Selectivity Greater Power

with

AERO COIL
SUPER-SENSITIVE
INDUCTANCE UNITS



TUNED RADIO FREQUENCY KIT

$12.00

Replace your present inductances with this Aero Coil Tuned Radio Frequency Kit. It will positively improve the performance of your receiver. Special patented Aero Coil construction eliminates radio frequency losses. You will notice instantly, a tremendous improvement in volume, tone and selectivity.

This kit consists of three matched units. The antenna coupler has a variable primary. Uses .00035 condenser. Coils are uniformly air spaced. No dope is used. Consequently they tune into resonance on a "knife's edge."

***FREE* with each kit**

Eight page color circuit, layout and instruction sheet for building the super-sensitive 5 tube Aero-Dyne Receiver packed with each kit. Extra copies, 75c each. Get yours TODAY from your nearest dealer.

Aero Products, Inc.
Dept. 105, 1772 Wilson Avenue
Chicago, Ill.

LEBNITE

THE POWERFUL NEW MULTIPOINT FIXT DETECTOR

75c Post Paid

75c Post Paid

The Super-Power Crystal

Double Volume Double Distance
Perfect for Reflex — Great for Crystal Sets
From your dealer or direct. Dealers write for discounts

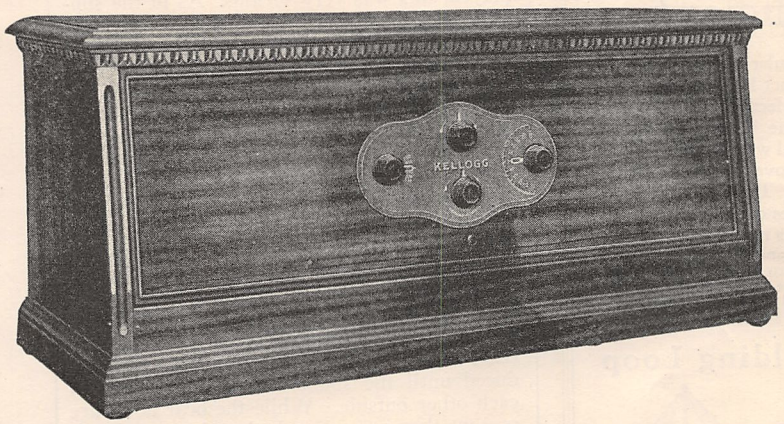
PALMER & PALMER
404 W. Utica St. Buffalo, N. Y.
Makers of the Famous
MULTIPOINT LINE

Kennedy & Kennedy, 1442 Yonge St., Toronto, Ont., Exclu. Can. Distr

KELLOGG

Flawless Reproduction

Radio



Licensed under application for letters patent of Radio Frenquency Laboratories, Inc. [R F L.]

Backed by 29 Years' Telephone Experience

Model 508 includes the apparatus of the table model and the wonderful new, long air column Kellogg speaker, with ample space for all batteries or power supply units.

FLAWLESS, faultless radio reproduction such as Kellogg has attained can come from experience alone. In radio set building, nothing — absolutely nothing — matches experience.

Model 507 receiver is the finished result of our 29 years' experience in voice transmission — a set that cannot squeal or howl — that brings them in with a "punch" to delight the most critical radio fan.

Heavy shielding around and between the coils prevents interference, and three stages of radio frequency give maximum range and selectivity. Take our word for it—here's a receiver that's as perfect as can be made.

Mail this Coupon *Now* for full details of the new Kellogg 507 receiver with the refinements and improvements possible only from an experienced institution like Kellogg.

Kellogg Switchboard & Supply Co.
1066 W. Adams St., Dept I-L, Chicago

DEALERS FRANCHISES

Dealers now receiving franchises. Write and let us tell you all the things we are doing to make Kellogg sets sell BIG.

Mail the Coupon Today

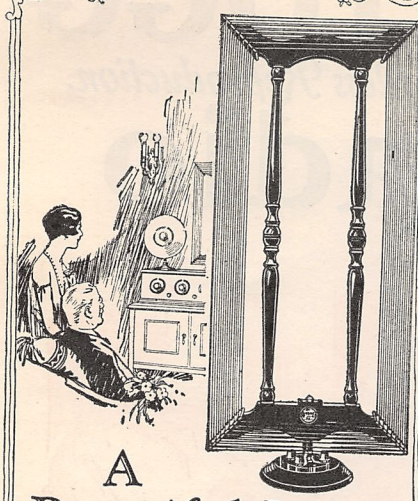
Dept. **1-L**
Kellogg Switchboard & Supply Co.
1066 West Adams St.
Chicago, Illinois

Please send me full information on the Kellogg Six Tube Receiver, model 507, and on the console model 508.

Name _____

Address _____

If a dealer, interested in a Kellogg Sales Franchise, check here ☐

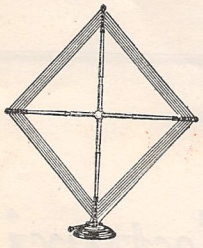


A Beautiful Loop That's Remarkably Efficient

THE current popular requirement for a beautiful, compact loop that is highly efficient is met perfectly by the Bodine De Luxe Loop. The beautifully proportioned hand rubbed walnut frame of this attractive loop improves the most tastefully furnished room. The De Luxe Loop is but 12 x 26 inches over-all, yet its outstanding efficiency is remarkable. By tuning out interferences and reduction of static this efficient loop materially improves tone quality. Designed for loop sets, but can be used with many aerial sets. Price, Bodine De Luxe loop all models $12.00.

Bodine Folding Loop

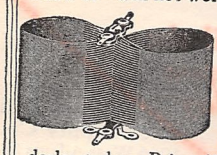
Simple, compact, and very efficient. This remarkable loop is a great favorite with owners of loop sets. Basket weave winding improves efficiency. Wire is especially designed to avoid stretching, and holds its shape under long service. Price, Bodine folding loop $8.50 to $10.00.



About Twin-Eight Coils

Reliable Radio Laboratories, Escanaba, Michigan, writes: "We have decided to use Bodine Twin-Eight Coils in our sets for the following reasons:

"They are more uniform than any other. "Their actual output of amplification is higher than any of the other coils used in comparative tests. "They have practically no interinductance between stages even when placed very close together—in fact at a space where circular coils begin to show interinductance. "They handle extremely well in any circuit. "They can be used easily in circuits where any other coils—that we know of—will not work at all."



The opinion of Reliable Radio Laboratories is based on extensive comparative tests and should be of great practical value to set builders. Order Twin-Eight Coils from your dealer today. Price, $2.00 per coils—three matched coils $6.00.

Mail the Coupon

BODINE ELECTRIC COMPANY,
2264 West Ohio Street,
Chicago, Illinois.
Kindly mail FREE circular describing:
Bodine Radio Loops.
How to use a loop with aerial receiver.
How to build the Bodine Twin-Eight Receiver.

Name _____

Address _____

tube, as shown in Fig. 1, it was first connected to a 1000-turn honeycomb coil, coupled to the transformer windings. (In fact the windings were placed inside of the honeycomb coil.) Our first Pianorad comprised twenty-five oscillator tubes, one for each note on the key-board, and twenty-five honeycomb coils, connected in series, and coupled to the oscillator windings. This arrangement was made in the belief that one loud-speaker could be used for all tubes. The output from the twenty-five coils was amplified by a power tube, in the plate circuit of which was placed the loud-speaker.

With this arrangement a very peculiar phenomenon was observed. When all the circuits were accurately tuned, the music played on the instrument was very melodious. However, a slight change in the pitch or frequency of one or more of the circuits, due to slight variations of the filament current or other causes, produced a very disturbing effect. For example, if middle C and high C were exactly in tune, the *second harmonic* of middle C would fall in phase with the *fundamental* of high C, and the two notes would harmonize. If either of the notes fell slightly out of tune a powerful beat would result and when chords were played, this was very serious. As in the superheterodyne, the beat note is of a frequency equal to the difference between the two frequencies producing it; and in the above case it is the difference between the frequency of the second harmonic of middle C, and the fundamental of high C.

As the beat note is considerably stronger than either of the two notes producing it, and as all three were amplified and then passed through the loud-speaker, the interference caused by the beat was so great that all musical harmony was lost. It is impossible to maintain the circuits in an absolutely constant state and the only alternative is to employ a separate loud-speaker unit for each tube. By so doing no beat note is produced until the sound waves interfere with each other outside. While the beat notes are present they are so weak that they can hardly be detected by ear.

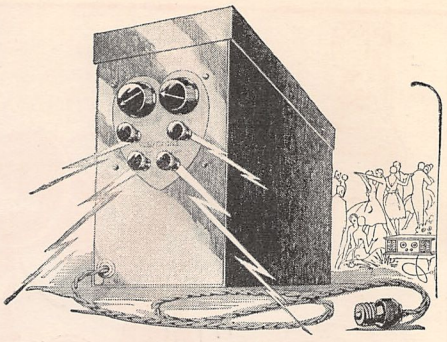
SIMPLIFYING THE ASSEMBLY

Illustrations in the November issue show the twenty-five loud-speaker units mounted on one sound chamber which opens out into a bell-shaped horn. Each unit was connected to its respective vacuum tube and switch on the key-board. As adjustable units are used, the volume of each note can be regulated until all are uniform. It is obvious that, by the use of a separate unit for each note, the honeycomb coils could be eliminated; and each unit is connected to its respective plate circuit, according to Fig. 1.

Perhaps Fig. 2 will give a better idea of the connections. Here only four tubes are shown; the other twenty-one, however, are all connected in like manner. A voltmeter across the filament terminals is required, because a slight change in filament current will throw the apparatus out of tune. When it has been once tuned at the proper voltage it is necessary to adjust the filaments to the same voltage every time the instrument is to be played.

As the twenty-five type 201A tubes draw 6¼ amperes, a heavy duty 7-ampere filament rheostat, mounted on the back of the cabinet, is used. A "B" battery of 90 volts is sufficient; as "B" current is used only when the keys are depressed, the ordinary radio batteries are large enough.

The assembly of the apparatus is clearly shown in the illustrations. The vacuum tubes, with their accompanying coils and condensers, are mounted on shelves and placed in the console cabinet. Each shelf has its filament and loud-speaker binding posts; so that the connections to it can be



VELVETONE

The "B" Battery Eliminator with an exclusive principle

OPERATE your set from the light socket and enjoy *better* Radio reception than ever possible with troublesome "B" batteries. VELVETONE, the new improved "B" battery eliminator, employs an exclusive principle not found in any other eliminator. A refilteration process takes place in the VELVETONE circuit, which removes every particle of minus pulsation before current enters receiving set. Positively insures a velvety flow of maximum "B" current at all times—free from hum or distortion. VELVETONE gives more volume and improves tonal quality of reception. Brings in weak and distant stations without strain on tubes—never runs down.

No working parts to get out of order, or be replaced. Built to last indefinitely. Guaranteed to operate any receiving set satisfactorily, no matter what style or size. **Price $31.95** installed complete. No further expense, except about 50c a year for electric current from your house lighting circuit. Write today for descriptive literature, giving name of your Radio dealer.

OUTPUT TABLE

Load	Voltage
10 mils. -	166
20 mils. -	146
30 mils. -	130
40 mils. -	116
50 mils. -	104
60 mils. -	90
70 mils. -	80
80 mils. -	70

DEALERS:

Write or wire for our attractive selling offer for your territory . . . . . 137 dealers secured in Los Angeles County in August.

VELVETONE CORPORATION
3729 Avalon Blvd., Los Angeles, Calif.

VELVETONE
"B" BATTERY ELIMINATOR
The Heart of the Radio

Look for the Trade Mark

TOBE

on the condensers you buy and make sure they are for the proper voltage.

Tobe Deutschmann Co., Cambridge, - Mass.

Irons Out the Wrinkles in Lighting Current

Solution level always visible.

Amplifier knob gives range from 65 to 115 volts on amplifier tubes — (120-160 volts on power tubes).

Detector knob gives regulation from 10 to 70 volts.

On and off switch.

Only four connections to make.

Ample power for ten-tube sets. Can be used with power tubes.

Plug can be left permanently in lighting socket.

ENLARGEMENT OF CONTROL PANEL

The Willard Selling Plan for Radio Dealers

Your local Willard Service Station will act as your jobber on Willard Radio Products.

This means a quick source of supply for strictly fresh material which you can turn over to your customers in the pink of condition.

Your local Willard Service Station will also assume the responsibility for service, if needed.

Months of operation have proved that this plan is effective, and profitable for all concerned.

Willard Radio Products will be advertised extensively this fall. Doubles and full-pages in The Saturday Evening Post and other leading publications.

The Willard "B" Power Unit

Here's a Radio Power Unit that takes hold of house lighting current and irons it out s-m-o-o-t-h so you can use it for steady "B" power in your radio set.

No acid in this unit. Just a harmless solution which won't do a bit of damage if you happen to spill it. No tubes to wear out, either.

And you can depend on it to deliver a continuous flow of steady "B" power in any type of one to ten-tube radio set, including those using power tubes in their audio stages.

WILLARD STORAGE BATTERY CO.
CLEVELAND, OHIO, U. S. A.

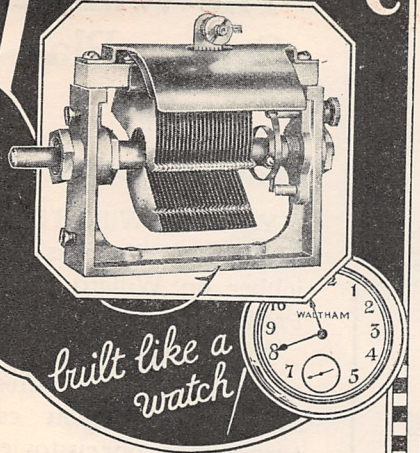
Have your local Willard Service Station explain the details of this practical plan for advertising and selling radio products. The advertisements are signed:

The Willard Battery men
and their
Authorized Radio Dealers

Appropriate signs and window cards will identify you as an Authorized Dealer. Booklets and other valuable selling helps will be furnished.

Your Nearest Willard Service Station is Your Nearest Willard Jobber

Precision



Precision

of detail, both electrically and mechanically, is what places so far ahead of the field the

Samson Uniform Frequency Condensers

Electrically this condenser has mathematically proportioned plates so that *all* stations are uniformly spaced. The dielectric is small and well removed from the field. The plates are small and close together avoiding losses due to fringing effects and large plate area and are plated for high surface conductivity.

Mechanically this condenser is the smallest made. It is built on a rugged frame capable of mounting in all positions with or without single-hole mounting. The rotor is of heavy construction having cone bearings on either end and should wear indefinitely without adjustment. A shield is incorporated with the condenser to protect against injury and dust.

The Samson Uniform Frequency Condenser is furnished in five sizes: Prices 500 mmf., $7.50; 350 mmf., $7.25; 250 mmf., $7.00; 125 mmf., $7.00; 75 mmf., $7.00.

Our book "Audio Amplification"—already accepted as a manual of audio design by many radio engineers — contains much original information of greatest practical value to those interested in bettering the quality of their reproduction. Sent upon receipt of 25c.

Samson Electric Co.

MEMBER RMA

Main Office Canton, Mass. — Manufacturers Since 1882

removed and the shelf can be taken out for repair or other purposes.

The process of tuning the Pianorad is very simple. Of course, each tube is first roughly adjusted to the proper frequency by means of fixed condensers, after which the final adjustment is made by means of the iron wires placed in the center of the coils. Anyone with a musical ear and a piano or other musical instrument for comparison will have little difficulty in tuning the Pianorad.

A 14-Tube Receiver

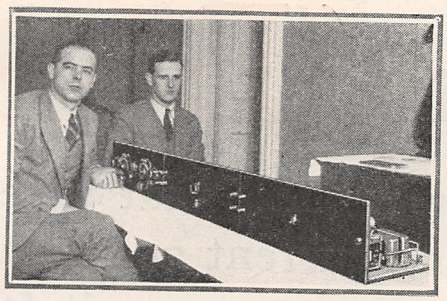
(*Continued from page* 641)

must not cut off the side bands. It has to be faithful in reproduction, without any distortion in the receiver itself, even on powerful signals. It also must go below the static levels; and the amplification must be great enough so that any signal that actuates the grid of the first tube, will come through with loud speaker strength.

With all of these specifications in mind, work was started, but not in the usual way; in fact, it was just opposite. First, a good detector and audio amplifier was built that did not cause any complications; and sufficient amplification was obtained without any distortion to operate a loud speaker at normal volume. This part of the circuit will be omitted, as no trouble was experienced in the construction of it.

FIVE STAGES OF R.F.

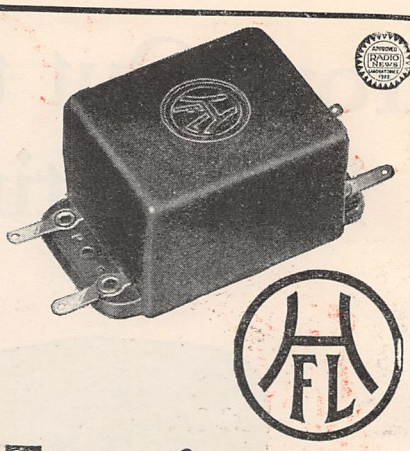
To this was coupled a five-stage, untuned, cascade radio frequency amplifier, (Fig. 2) designed to cover a wave band from 200 to 600 meters. The windings of the radio frequency transformers were staggered, so that each tube was kept just below the oscillating point. This system of intermediate-radio frequency amplification was found to be superior to the superheterodyne system when using so many stages, for several reasons: *i. e.,* first the danger of cutting off the side bands, which gives you most of your



Even though this receiver has many tubes, the control of it is simple.

delicate harmony and overtones, which could happen in the superheterodyne system by too sharp a tuning of the intermediate transformers, is eliminated; second, the matching and balancing of tubes and transformers is also eliminated, for the same reason as in the first, because this intermediate amplifier covers a wide band of frequency; third, the potentiometer control is eliminated, which simplifies the operation of the receiver, besides allowing the correct negative biasing of the tubes, so that each tube may operate at the correct part of its characteristic term, which prevents distortion, as well as keeping it from being critical.

Now that we have a simple, yet very efficient as well as stable means of radio frequency amplification that is capable of building up the weakest signal, to a point at which it will be rectified by the detector, the next problem, a simple yet selective means of tuning, will be taken up. This part of the circuit is given in a schematic diagram (Fig. 1).



Transformers

Give Finest Radio Reception

These improved transformers assure selection of radio programs at choice, regardless of broadcast conditions. They combine tremendous power with an unexcelled purity of tone and amplify the weakest signals to full loud speaker volume. They operate with all types of standard tubes. Unsurpassed for quality, clarity and volume.

Praised — Endorsed — Approved

H. F. L. Units have been heartily endorsed by such leading Radio Authorities as Radio News—Citizen's Radio Call Book—and Radio Age.

H. F. L. Users Write: "Picked up Rome, Italy, from Evanston. Also Aberdeen and Edinburgh." "Lima, Peru, came in on my H. F. L. Receiver with full loudspeaker volume." Get coast to coast from Chicago regularly using H. F. L. Units."

PRICES

H. 210 Iron core transformers with an exceptionally high amplification factor. Each unit carries laboratory calibration. Range 32,000 to 42,000 cycles. Price **$8.00**

H. 215 Air core transformer, tuned stage, designed to amplify signals at a maximum efficiency of 37,000 cycles. Each unit carries the laboratory calibration. **Price $8.00**

F. 320 Audio frequency transformer which will amplify signals to greatest volume with incomparable faithfulness of tone. These units are the result of an entirely new principle in transformer construction. **Price $8.00**

L. 425 Radio Frequency Choke Unit. **Price $5.50**

L. 430 Low Loss Radio Frequency Transformer. **Price $5.50**

Jobbers Write Today *Dealers*

Try H. F. L. Units for Better Results. If your Dealer cannot supply you order direct.

HIGH FREQUENCY LABORATORIES

129 N. Wells Street

Chicago — **Illinois**

MURRAY UNIT
REALLY ENDS TROUBLE

For constant Radio "A" power; can be operated while set is in use. Simply connect to light socket. No adjustment; no wires to change; no low batteries. Equipped with hydrometer in cap for gravity test and 2-amp. G. E., Tungar bulb. Delivered ready to use. **$29.50 LIST**

Agents Wanted! Murray Distributor 4837 N. Robey St., C, CHICAGO

Write Today for Our 84-Page Catalog of RADIO BARGAINS

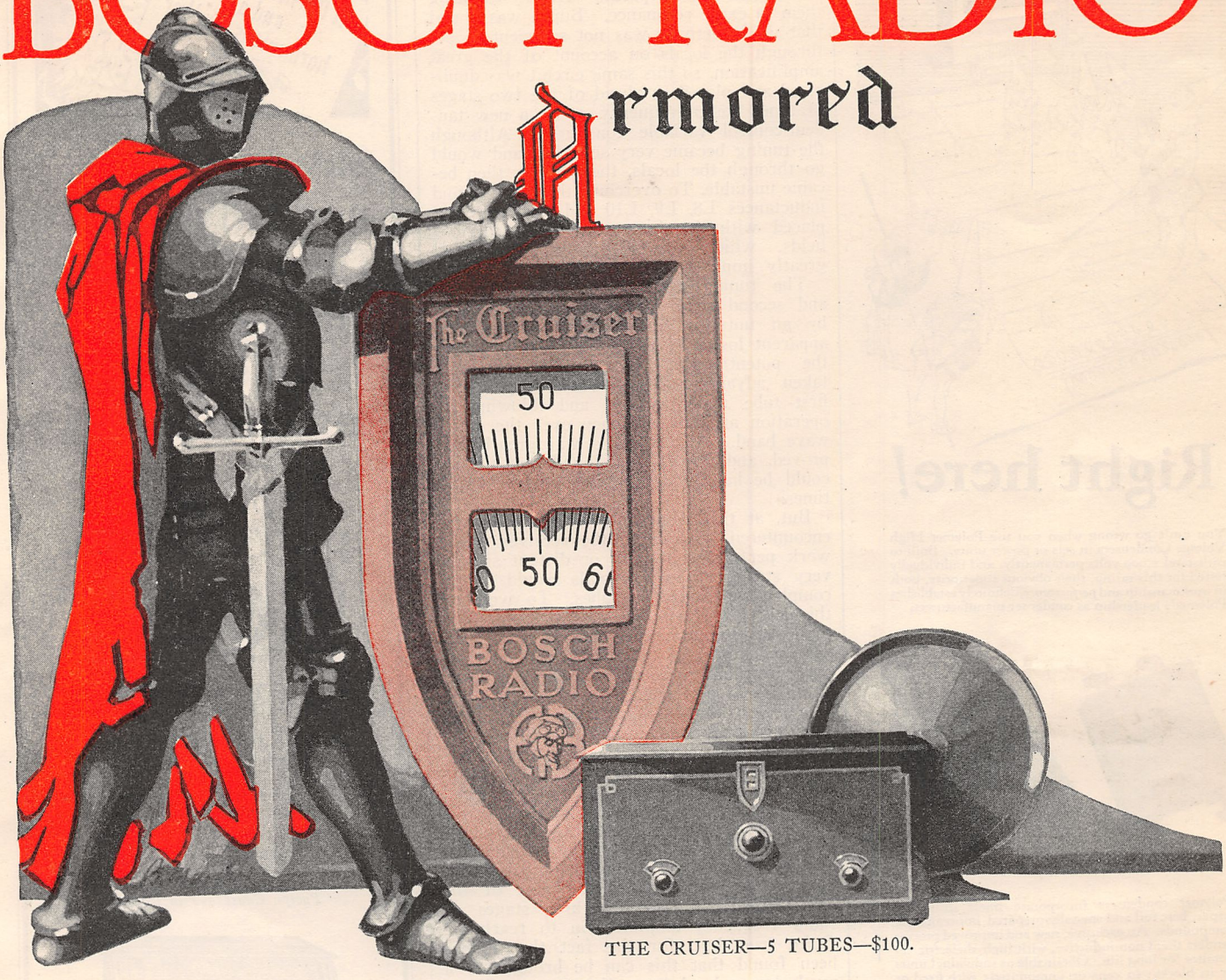
RANDOLPH RADIO CORP.

180 N. UNION AV. — Dept. 2 — CHICAGO, ILL.

Insure your copy reaching you each month. Subscribe to RADIO NEWS — $2.50 a year. Experimenter Publishing Co., 53 Park Pl., N.Y.C.

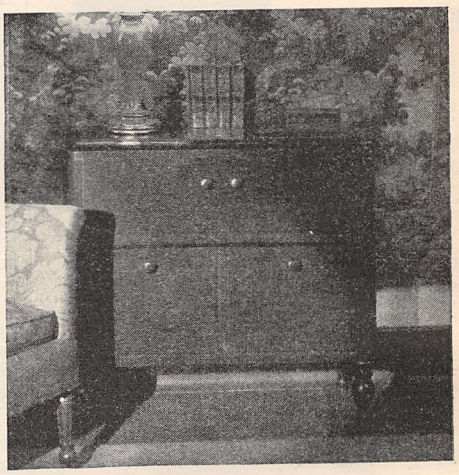
BOSCH RADIO

Armored



THE CRUISER—5 TUBES—$100.

The new Bosch Radio models are finer, more powerful, easier to operate, more beautifully incased. Built to please the radio wise purchaser, Bosch Radio upholds the judgment of those considered experts. Completely armored and shielded, the five tube Cruiser sets a new standard in performance and tuning simplicity for receivers up to double its price. It has unified control, a single station selector for most tuning, and two dial advantages for "Cruising the Air." The Amborada is an armored and shielded seven tube receiver, built on a steel chassis for rigidity and long life. Its great power and unusual ability will be a revelation to even the more seasoned radio veterans. Its single station selector is graduated in wave lengths, eliminating multiplicity of dials and troublesome tuning, and its clear, tonal range is from a whisper to orchestra volume. This receiver is incased in a low handsome, early American period cabinet, with ample room for all batteries, chargers and power units. Bosch Radio offers a wide selection—five, six and seven tube receivers, two cone type reproducers, the famous NoBattry "B" Power Unit and other equipment. Hear Bosch Radio at your Bosch Radio Dealer. We will send you his name upon request.



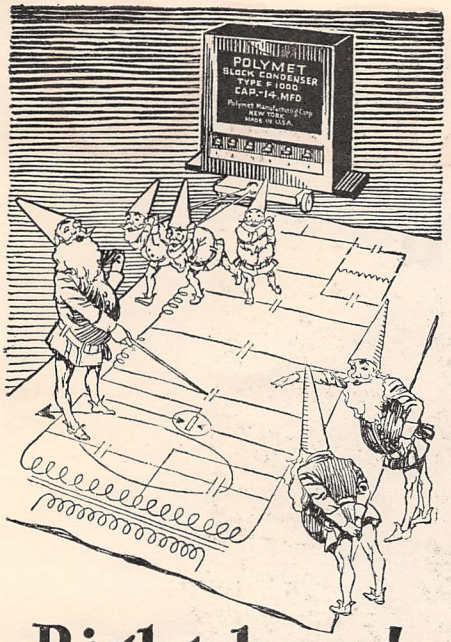
THE AMBORADA—7 TUBES—$310.

All prices slightly higher Colorado, West and in Canada

AMERICAN BOSCH MAGNETO CORPORATION

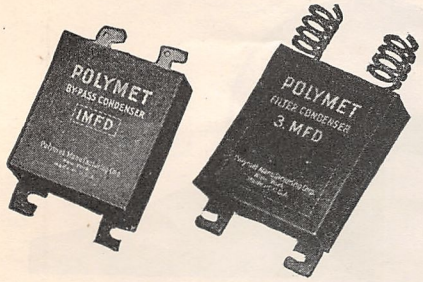
SPRINGFIELD, MASS. Branches: New York, Chicago, Detroit, San Francisco

Manufactured under patent applications of the American Bosch Magneto Corporation and licensed also under applications of the Radio Frequency Laboratories, Inc.



Right here!

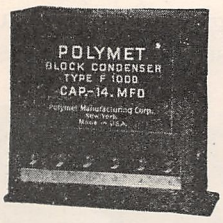
You can't go wrong when you use Polymet High Voltage Condensers in sets or power units. Built to withstand 1,000 volts permanently, and individually tested for this rating, their obvious superiority, both in workmanship and *performance*, definitely establishes Polymet's leadership as condenser manufacturers.



Polymet condensers incorporate finest insulating paper, best foil and specially prepared impregnating compounds. An exclusive, new and improved process renders them non-inductive, with high dielectric resistance for long life. Obtainable as individual units or in blocks; in cans or unmounted; with fixed or flexible leads.

Capacities .1 to 5. Mfd. . **60c to $4.50**

Raytheon Circuit Blocks



Tested by the Raytheon Laboratories, they have passed with highest honors and been given an enviable rating.

F1001 .1-C-.1 Mfd. . . **$2.00**
F1000 14 Mfd. **9.50**

Polymet Products are used by over 125 high grade receiver and power unit manufacturers. There's a reason—Polymet Products have passed their exhaustive tests! Follow the manufacturers—specify Polymet Products—at all good dealers everywhere.

Illustrated descriptions sent FREE on request.

Polymet Manufacturing Corporation
599 A Broadway - New York City
"World's Largest Manufacturers of Radio Essentials"

POLYMET

Two stages of tuned radio frequency amplification were used ahead of the intermediate amplifier; and to simplify the tuning of the two condensers, C3 and C4 were in tandem, with separate verniers to bring them in exact resonance. But it was found that the selectivity was not sufficient to cut through the locals on account of the great amplification, so this same circuit was duplicated and placed in ahead of the two stages of tuned radio frequency, using a new tandem-control variable condenser. Although the tuning became very selective, and would go through the locals, the receiver then became unstable. To overcome this the solenoid inductances L8, L9, L10 and L11 were replaced with doughnut coils, with confined fields, which prevented feed-back, and greatly improved this stability.

The tuning coupling between the first and second radio tubes was then replaced by an untuned transformer, without any apparent losses in selectivity; and by using the potentiometer P1, regeneration was taken advantage of, thereby keeping the first tube under control and allowing its operation at peak efficiency over the entire wave band. Also stability was greatly improved, and it was now found that the set could be kept under perfect control at all times.

But, at this point, another difficulty was encountered. Although the receiver would work perfectly on weak or distant signals, very strong or local signals would almost completely paralyze the tubes. To overcome this a reverse winding L6 was placed in the aerial-ground circuit, bucking L5. Therefore, when both of these coils were in exact opposing relations to each other, there could be no transfer of energy to L7. Therefore, it is obvious that by adjusting either of these coils any amount of energy up to the maximum, flowing in the aerial and ground circuits, could be transferred to L7, by induction; thereby preventing the overloading of the circuit and paralyzing of the tubes.

Now the old question arises, "the static level?" Why have all of this tremendous amplification, if you cannot work below this point, as most of the better sets of the day utilize only two or three stages of radio frequency amplification to reach it? Quite true, but, for the fact that it has been found that this can be brought to a much lower level by utilizing an oscillator ahead of your tuner, and very loosely coupling it to a pick-up coil, L4, which is shunted around L6, in series with a small variable condenser to control the amount of energy transfer. With this arrangement L5 and L6 can be permanently fixed; and L6 is then balanced electrically by the oscillating frequency of the oscillating tube, this being governed by the tuning condenser C1. This condenser is in tandem with C2, which keeps the tuning controls down to only two; and any one with two hands may readily operate them without any difficulty, as both tuning control dials practically log together.

Now that L5 is permanently opposed by L6, there is no transfer of energy to L7, except when L6 is balanced electrically by the frequency of the oscillator, which must be the exact frequency of L2; and the amount of energy transfer is controlled by the vernier of C1. This oscillator improves the selectivity to such an extent that little or no trouble was experienced in going through the locals, with only a few meters separating the locals from the distant stations.

The filament circuit has not been complicated, due to the fact that it was found that the circuit of Fig. 1 and Fig. 2 could be controlled entirely by two rheostats; each rheostat taking care of five tubes, and once set for the correct resistance, so that the filaments would be at the proper temperature for the most efficient operation, no further adjustment was required, and this point was not at all critical.

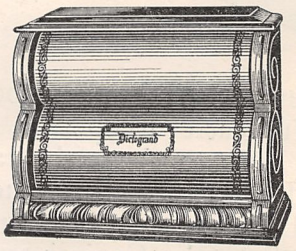
Say it—
not only on December 25th but for many joyous months to come with

The New
DICTOGRAND
ROLL
SPEAKER

Try it on your radio—with your dealer's compliments . . .

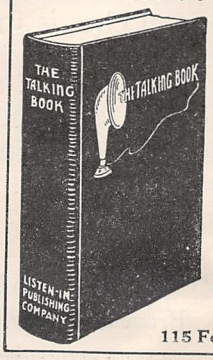
Three models . . . . . The DeLuxe (illustrated), $25.00
The Standard $16.50
The Tabouret $40.00

Prices slightly higher on the Pacific Coast and in Canada



Made by
DICTOGRAPH PRODUCTS CORP.,
New York City

Best Yet in a Detector Set



"TALKING BOOK"

A Complete Radio Set

Pair of standard Ear Phones, Aerial and Ground Leads, Indoor Antenna. Self contained in attractive book.

With Celerundum Rectifier —No Batteries Required.

Price $3.50

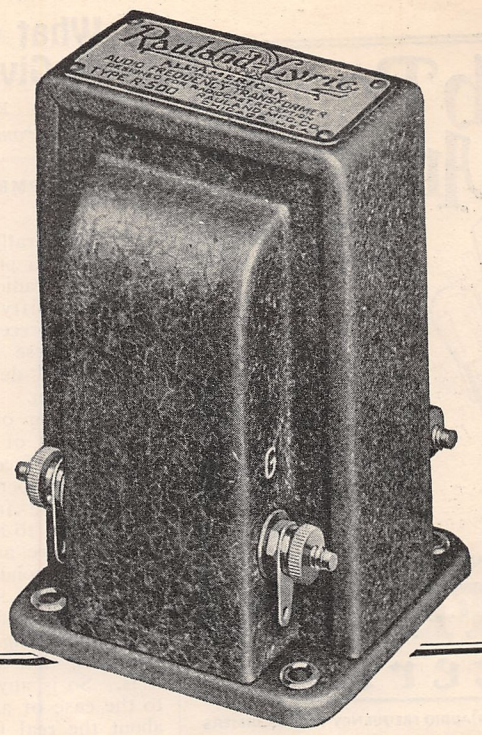
With Ear Phones $6.00 at your dealer or direct.

THE LISTEN-IN CO.,
115 Federal St., Boston, Mass.

Insure your copy reaching you each month. Subscribe to RADIO NEWS — $2.50 a year. Experimenter Publishing Co., 53 Park Pl., N.Y.C.

Still the undisputed leader

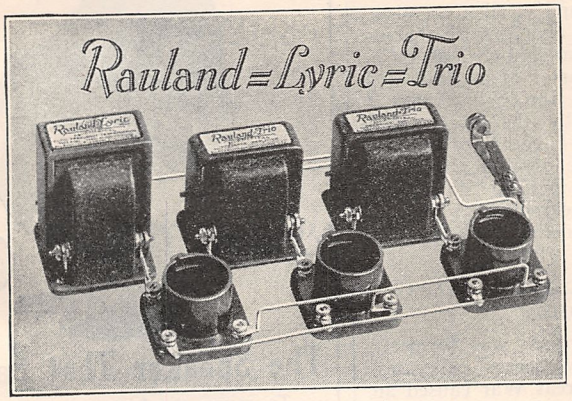
Rauland-Lyric
AUDIO TRANSFORMER



If you love music, and want your radio set to reproduce tones *faultlessly*, there is one audio transformer you can absolutely depend on—the famous Rauland-Lyric.

Voices and instruments alike are amplified with amazing realness by the Rauland-Lyric; with faithful amplification of those "overtones" essential to full, natural reproduction. The amplification curve of the Rauland-Lyric illustrates its outstanding superiority in tone purity.

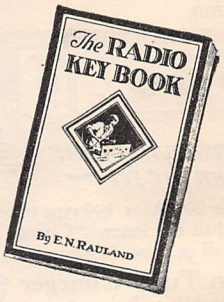
The Rauland-Lyric is the undisputed leader in its field. It is invariably chosen by set builders who want the utmost in perfect tone quality.



Write for "Modern Audio Amplification", a free book, describing this fine unit.

A new high mark in three-stage audio amplifiers

Your receiver's tone quality depends in large measure on correct audio amplification. The famous Rauland-Lyric Transformer may now be combined with two Rauland-Trios (impedance units) to form the Rauland-Lyric-Trio —the highest known perfection in three-stage audio amplification. Rauland-Trio is a compact, well-made unit — containing in one shell — inductance, resistance, and capacity in correctly balanced relation.



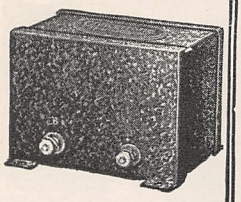
New 1927 Radio Key Book

You'll enjoy reading it—48 pages of interesting, up-to-the-minute facts about radio, simply told. Also full construction details of all leading types of circuits. Send 10 cents (coin or stamps) to cover postage and mailing cost.

ALL-AMERICAN RADIO CORPORATION
4209 Belmont Avenue, Chicago, Illinois

OWNING AND OPERATING STATION WENR 266 METERS

With Power Amplifier Tubes



—be sure to use

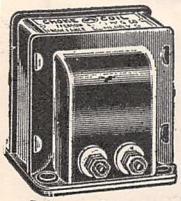
JEFFERSON Concertone

(AL-2 SEALED) AUDIO FREQUENCY TRANSFORMERS

BECAUSE they are built with sufficiently large as well as heavily insulated core and winding to insure *safe and continuous use with power tubes without danger of burnout or breakdown.*

Concertones are specified in latest circuits for the reason that they do not lose, distort or "blast" any audible notes from the lowest (30 cycles) to the highest (10,000 cycles). $6 each at your dealer's.

The Jefferson No. 358 Filter Choke should be installed in every set using power tubes in the last stage. It controls the heavy plate current, which otherwise causes "blasting" in the loud speaker and may also burn out the windings. Inductance 30 henries, DC resistance, 300 ohms.



Jefferson No. 358 Filter Choke, $5

Without removing your tubes from the set—

Keep your 201-A or 199 type tubes like new—at full efficiency. "Charge" them monthly, all at once, *in your set.*

Jefferson Tube Charger $3.50

Merely attach it to light socket and connect to set for 10 minutes. Rejuvenates run-down tubes. Guaranteed. Get one at your dealer's.

Write for latest literature describing all of the latest Jefferson Guaranteed Radio Products

Jefferson Electric Mfg. Co.

Largest manufacturers of small transformers

541 SO. GREEN ST. CHICAGO, ILL. U.S.A.

What Chemistry Has Given to Radio

By O. IVAN LEE

(*Cont'd from November* RADIO NEWS)

DEVELOPMENT OF THE INSULATING LACQUERS

It is generally conceded that the losses inherent in our present radio receivers emanate from the radio-frequency coils, amounting usually to fifty or seventy-five per cent. of the energy received. In humid weather, especially, these losses are very serious; the accumulated dust also is a great cause of deterioration. It has been found that a light coating of certain *pyroxylin* lacquers on the coils of a radio set, greatly reduces these radio-frequency losses and tends to stabilize the performance of the receiver, in spite of the fact that such lacquers have been shown to add to the dielectric capacity of both bare and insulated wire. The experts who condemn the use of "dopes" on coils take the same stand as the dieticians who rail at coffee because it contains caffeine; clinching the matter, as they see it, by saying that it is a stimulant. Of course, it is. So is any food, usually in proportion to the ease of assimilation. Nothing is said about the real food value of the sugar and milk. Similarly, the gain in stability of performance of a radio receiver equipped with "doped" coils outweighs any slight losses incurred through the slight increase in distributed capacity. These lacquers have been developed to a high state of perfection during the past few years for use in quick-drying lacquers and automobile finishes. They are complex and have five components —(1) the cellulose derivative (usually guncotton); (2) the solvent (a mixture); (3) plasticizers and stabilizers; (4) oils, gums and resins; and (5) the pigments or colors. Each of these components has been the object of a vast amount of research and experimentation by paint and varnish chemists, in particular, Nos. 1, 2, and 3; with the result that lacquers are available now which in the short space of a quarter of an hour will dry to a lustrous glossy film so hard that it can not be scratched by the finger nail. Doubtless we shall soon have a new enameled wire coated with one of these improved lacquers. Already, in fact, a "dope" for coating bus bar has appeared; as well as a kind of spaghetti evidently impregnated with such a lacquer.

USE OF "BOROSILICATE" GLASS IN RADIO

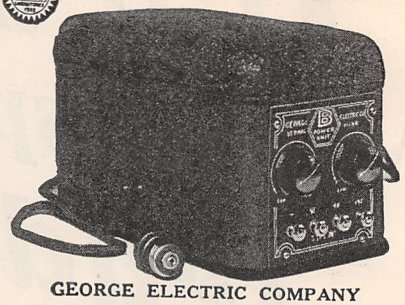
This superior type of glass was formerly made only in Germany by "secret" processes. The exigencies of the Great War caused an intensive chemical investigation of the nature of its composition, properties and method of manufacture; with the result that a glass was perfected far superior to anything ever "Made in Germany," in cost, toughness and resistance to extremes of temperature. It is now in widespread use, and in radio has appeared in antenna insulators, lightning arresters, tube sockets and supports for coils, where its improved insulating qualities greatly commend it. The glass used for tubes and cabinets is softer and of a different type.

Improved kinds of porcelain have also made their appearance and find similar uses, as well as in cores for resistance coils such as transmitting grid leaks.

BATTERIES

Radio has wonderfully stimulated battery production, resulting in both cheaper and better dry cells and storage batteries. This improvement has been largely brought about by the close study of the chemical questions involved; for it must be remembered that each device is one for the storage of electri-

COMPLETE WITH TUBE $25.00



GEORGE ELECTRIC COMPANY

"B POWER UNIT"

"Type M"

Delivers the proper voltage at all times without a trace of a hum. Sturdily constructed to last as long as the best radio set. Its fine appearance will add to the beauty of your receiver.

A full wave rectifier tube is used—no filament to burn out. Three taps with two variable resistances permit complete control of both detector and amplifier voltages up to 180 volts. This gives ample power for any set on the market.

A George Electric Company "B POWER UNIT" will remove all your "B" worries.

LOWER PRICE—HIGHER QUALITY POSITIVE GUARANTEE

Sold direct from the factory to you, or through our authorized representatives. Write for complete information. Shipped prepaid on receipt of $25.00, or C. O. D. $25.00 plus postage.

GEORGE ELECTRIC COMPANY

753 Carleton Ave. St. Paul, Minn.

Agents and dealers wanted!!! Write for attractive agency proposition.

Burns

The Speaker That Satisfies

To secure the best reproduction from any set a speaker of proper design must be used. The BURNS is capable of reaching the full range of tones with amazingly pleasing results. A trial will convince you.

At Your Dealers Or Write Direct

Manufacturer

American Electric Company

State & 64th Sts., Chicago

Ask About The BURNS "B" Eliminator

Our Radio Dealers Make Big Money

Dealers looking for big turnover and quick profits will send for this 96-page catalog of radios and accessories, including Bremer Tully, Balkite, All American, G. E. Tungar, Thorola, Majestic, Utah, R. C. A. Tubes, nationally advertised parts, batteries, chargers, etc. Write for catalog No. 91H, full facts, territories open, etc. Tell us about your business, as we sell wholesale only. Real money waiting. Don't delay.

NEW ENGLAND MILLS CO.

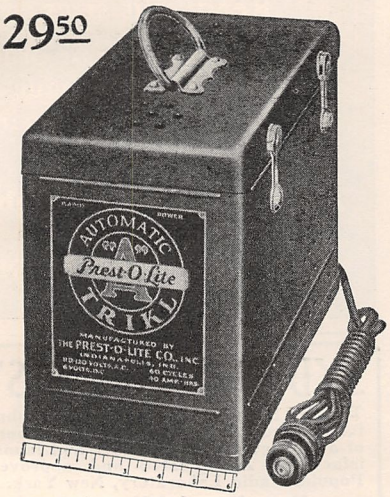
Distributors Nationally Advertised Radio Lines

Dept. 91H Chicago, Ill.

855 Washington Blvd.,

Announcing the new *Prest-O-Lite* Trikl-Automatic Radio "A" Power Unit

$29.50



Look at these new features

The battery. Ample capacity. Extra thick, rugged plates, deep-grooved separators. Unusually large acid volume requires infrequent watering. One-piece, leak-proof rubber case, with acid-tight cover. Screw post seal and double baffle vent to prevent leakage and acid spray.

The charger. Built on an entirely new principle. Silent in operation. Adjustable to needs of individual user. Economical to operate. Nothing to get out of order. Nothing to replace. Built to last for years.

No moving parts. No bulbs. No electrolyte. No water or acid to be added. No electrodes to wear out. *Entirely automatic.* No switches to operate by hand. Built-in power relay automatically shuts off the charger when radio is in use and turns it on again when radio is idle. Will operate at any distance from set.

Fully enclosed. Entire unit enclosed in beautiful metal case, with hinged cover and handle.

An "A" power unit combining Prest-O-Lite's fine storage battery with a trickle charger. A unit that can be plugged into an electric light socket, then hooked up to the radio set —and forgotten! It charges itself automatically.

It's new. Entirely automatic in action. No switches to operate by hand. Now you can have full storage-battery power for your radio *all the time.* Power that is noiseless and without the slightest pulsation, the kind of power that brings in the distant stations loud and clear.

Never again will you have to bother with a charger. Never again will a run-down "A" battery spoil your radio.

A thing of beauty.

The unit is beautifully finished in deep maroon. Small and compact. Even in full view under the library table it looks well.

You'll find further details in the column at the left. But the main thing is to see it. Go to the Prest-O-Lite dealer's store. There's one near you. Or write us and we will give you a lot of interesting facts about this wonderful new "A" power unit.

And remember, it is made by a company which has had more than twenty years of manufacturing experience.

THE PREST-O-LITE CO., Inc.
INDIANAPOLIS, IND.
New York San Francisco
In Canada: Prest-O-Lite Company of Canada, Ltd., Toronto, Ontario

RADIO DEALERS SHOULD WRITE AT ONCE FOR FULL DETAILS

Prest-O-Lite

Reliable Noiseless Powerful

KEEPS your set full of live, marvelous energy — banishes its dull, listless moments due to run down batteries. Improves tone, and cuts operating cost to almost nothing. Rigidly tested and fully guaranteed—the greatest "B" Battery Eliminator ever produced

Cornell Voltage Supply

("B" Battery Eliminator)

Equipped with long life Raytheon Tube which has no filament to burn out.

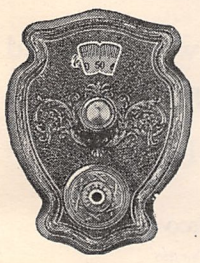
Type "B"—137 to 220 volts at 30 milliamps; 150 volts at 60 milliamps $39.50

Type "CB"—(illustrated above) 142 to 227 volts at 30 milliamps; 155 volts at 60 milliamps $49.00

(West of Rockies, add $1.90 to above list prices)

Sold only through authoried CORNELL Dealers

Tested and approved by Raytheon Laboratories



Beautify Your Set

With its deeply etched plate, in antique gold finish, this new attractive smooth friction, 9 to 1 vernier dial will beautify your set and make it a 1927 model. List Price $1.50

CORNELL ELECTRIC MFG. CORP.
Rawson & Annabelle Sts., Long Island City, N. Y.

Please send full information about your Cornell Voltage Supply; also name of nearest dealer.

Name .....

Address .....

☐ If dealer, check here and receive special dealer proposition.

cal energy in the form of chemical energy. Each chemical factor that goes into the construction of a dry cell—the zinc, the carbon, the sal ammoniac, the filler and the depolarizing compound, has received great consideration as to its proper qualifications for the purpose intended. The question of the purity of the chemicals has been found to be of great importance; the slightest trace of some foreign materials having a very marked effect on the life of the battery. On the other hand, in the case of the alkaline nickel-iron storage battery, it has been discovered that a little of the rare chemical *lithium hydroxide,* added to the caustic soda solution in which the plates are immersed, greatly prolongs the life of the battery. Just why this should be so, no one has yet found out.

CHEMICAL CONDENSERS

Certain metals, notably aluminum, retain their luster undiminished by virtue of the fact that nature automatically covers them with a thin, transparent protecting film of oxide, which shields them as does the lacquer which the silversmith uses to keep his ware from tarnishing. This oxide is an excellent insulator. Now in the construction of condensers, it is desired to place the two plates to be charged as closely together as possible without sacrificing the insulating power (dielectric capacity) of the substance between. For this reason, mica is widely used. It occurred to someone that the thin film on a metal such as aluminum is capable of being developed into an insulating layer of the character wished. Experiments were carried out with various chemical solutions designed to cause the formation of such films, and ultimately it was found that certain compounds of *boron* were best suited for use in these liquid-type electrolytic condensers. They have a very large capacity for their size, break down at moderate voltages, and are self-healing when punctured, features which make them of peculiar usefulness.

Furthermore, it was found that when the film-coated metal was immersed in certain solutions, and an alternating current passed, the film behaved like a valve, allowing the current to pass in one direction, but not in the other. Although aluminum rectifiers are quite practical and are still used, the most recent apparatus utilizes the new and rare metal *tantalum,* which has the unique advantage that it is chemically everlasting, since it is not attacked by the sulphuric acid employed to conduct the current through the rectifier.

It may be mentioned, in passing, that the production of this rare metal tantalum was itself the culmination of some seven years' patient and laborious chemical research costing hundreds of thousands of dollars. However, anyone may now buy this wonderful non-corrosive metal for somewhat more than $100 per pound, which in plate form goes a long ways.

SYNTHETIC CRYSTAL DETECTORS

The crystal detector has been with us since the pioneer days of wireless and still has a large following who are entranced by its simplicity, tone quality and low cost of upkeep. Two of the most popular substances in common use, *silicon* and *carborundum,* are both obtained by the chemist's art in the electric furnace. In addition certain chemically prepared compounds similar in composition to the sulphide mineral detectors, such as galena, have been devised and are very efficient.

This same element silicon whose oxide is so well known as sand, quartz and "rock crystal," is also an essential constituent of silicon steel which is used for the laminations of transformer cores. This steel adds greatly to the efficiency of the transformer; which, as people are beginning to realize, is vital to the circuit so far as tone quality is concerned.

START THAT NEW CIRCUIT with a Genuine

RADION PANEL

"The Supreme Insulation"

SUPERIOR insulating characteristics. EASILY cut and drilled.

RESISTS warping.... Positively MOISTURE PROOF.

Ready-cut sizes.

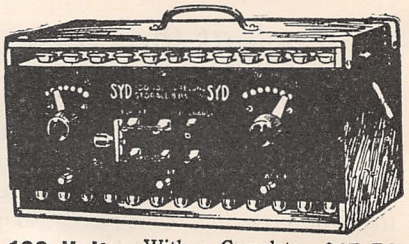
From your dealer or order by mail..... Catalogue of Radion Panels and parts on request.

American Hard Rubber Company
11 MERCER ST., NEW YORK

SYD LIFE LONG STORAGE "B" BATTERY SYD

The Syd Storage "B" Battery was submitted for a thorough test to the Radio Laboratory of a Chicago daily newspaper and found satisfactory. Also tested and approved by Popular Radio Laboratory, New York.

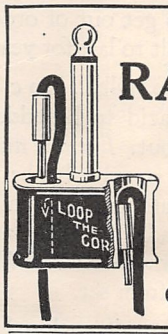
Unconditional 2-Year Guarantee



100 Volts With a Complete Charger $15.50
145 Volts With a Complete Charger $21.50

MAIL ORDERS PROMPTLY FILLED

SYD STORAGE "B" BATTERY CO.,
1453 S. Wabash Ave., - Chicago, Ill.



A NEW RADIO PLUG

Simple to use, gives perfect electrical contact with any style tip.

Simply push cord tip through plug, loop cord and push tip back into plug.

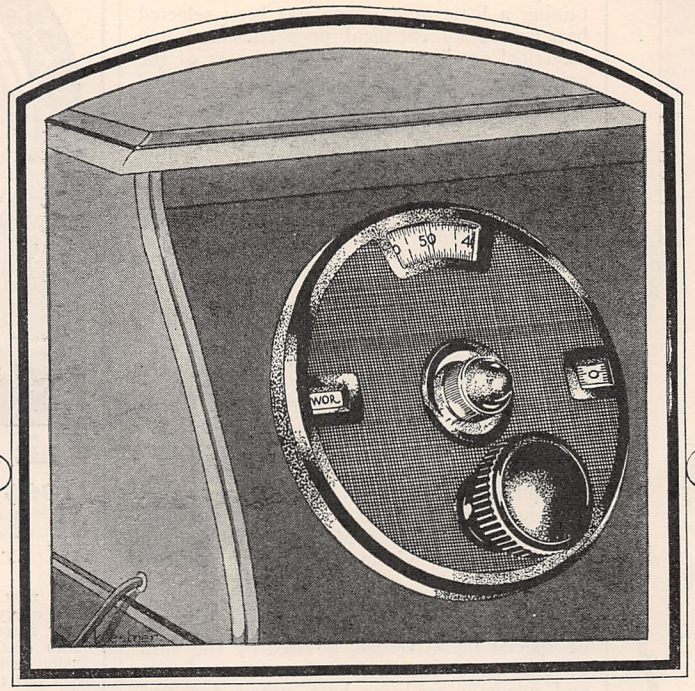
Sent postpaid on receipt of 50c

CULVER-STEARNS MFG. CO
Worcester, M.sas

TELEGRAPHY

(Morse and Wireless) and RAILWAY ACCOUNTING taught thoroughly. Big salaries; great opportunities. Oldest, largest school. Endorsed by Telegraph, Railway, Radio, and Government officials. Expenses low — opportunities to earn large portion. Catalog free.
DODGE'S INSTITUTE, Swan Street, Valparaiso, Ind.

FRICTION DRIVE~NO BACKLASH



MAR-CO standard 4 in. dial . . . scales either 0 to 100 or 100 to 0. Black or Mahogany, with metal either nickel or gold-plated.

You might as well *get* what you pay for

New developments in radio, that have *real merit,* are quickly recognized.

A year ago, when MAR-CO dials were new, they were greeted with an immediate storm of approval.

They met a definite need . . . they provided *precise* tuning . . . smooth, instant responsiveness . . . and "friction-drive", the action that makes backlash impossible.

Today, their searching action is the tuning standard . . . and 600,000 MAR-CO dials are actually in use.

For a long time, MAR-CO was utterly unable to meet the demand. Scores of similar-*looking* dials soon appeared.

But MAR-CO precision still distinguishes MAR-CO dials. And you can always identify them by the MAR-CO name on the familiar blue-and-yellow boxes.

You can pay *more* for a dial, now, and get no finer accuracy. You can pay *less*—and fail to get the searching dial-action you expect.

In any event, whether you *get* MAR-CO precision or not, you *pay* for it either in money or in the character of performance.

MAR-CO wants you to *get* what you pay for.

MARTIN-COPELAND COMPANY
PROVIDENCE, R. I.
Branch offices and representatives in principal cities.

MAR-CO DIALS

Below: The celebrated MAR-CO precision neutralizing condenser. Occupies small space, but has widely spaced terminals.

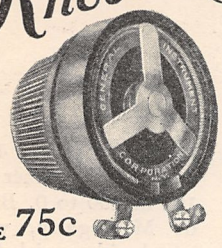
Above: MAR-CO 4 in. 360 degree dial. Scales read 0 to 200 or 200 to 0.

Left: MAR-CO 3 in. dial. Scale reads both 0 to 100 and 100 to 0.

Right: New MAR-CO rheostat dial. Matches vernier dials exactly in appearance and finish. MAR-CO knobs are also available, for other instruments, to match the dial knobs.

Below: MAR-CO miniature knife switches. Sure contacts, proof against "jamming". All types, S. P. S. T. to five pole double throw.

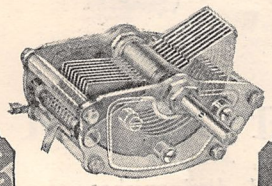
"LITTLE GIANT" Rheostat



LIST PRICE 75c

"ALL THE NAME IMPLIES"

The only rheostat which definitely eliminates the possibility of burnt out or broken resistance units. Perfect and velvet silent action. Bakelite insulated throughout. One hole mount. 6 to 30 Ohms.



METRALIGN

SLT STRAIGHT LINE TUNING

METRALIGN SLT is the only condenser combining Straight Line Capacity, Straight Line Wavelength and Straight Line Frequency, eliminating the faults and retaining the advantages of each type—the result is a perfect tuning unit.

METRALIGN SLT spreads stations so evenly over the dial that all stations on all wavelengths can be quickly and easily tuned in or out and accurately logged.

FREE

We have prepared a most comprehensive booklet on tuning. It is written in simple language and tells all you want to know about condensers. Write for a copy today.

General Instrument Corporation
477 BROADWAY NEW YORK, U.S.A.
Makers of "Bureau of Standards" Variable Primary Condensers

GRID LEAKS

One answer to the problem of devising a compact, efficient and variable high resistance, to be used as a grid leak, has been the perfection of sealed glass tubes containing a little fluid which has been selected because of its chemical properties and low electrical conductivity. The thickness of the column of conducting liquid can be varied merely by turning the tube around, thus changing its resistance. In this connection, it is interesting to recall that pure water is almost a perfect non-conductor. In fact Tesla found that ice made the best insulating medium when he carried out his classic experiments in high tension currents many years ago, since in ice, all the conducting impurities have been frozen out.

RESISTANCES

Radio has caused a big demand for compact resistances, especially for the graduated control of the current operating the filaments. This in turn necessitated special alloys adapted for the wire needed, a task which has devolved on the metallurgical chemist. Later, an ingenious device, resembling the well-known fuse in appearance, was invented, the iron resistance wire of which automatically controls the amount of current passing, within previously prescribed limits.

The parchment paper used in the construction of the cone-type loud-speakers is of special manufacture, devised by the skill of the paper chemist, to have the texture and acoustic qualities best suited for this purpose.

RARE METALS USED IN RADIO

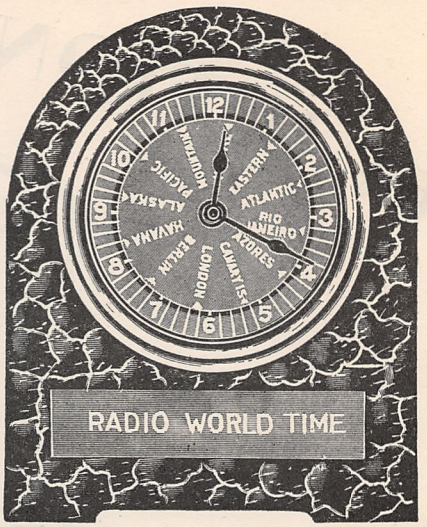
Perhaps the greatest contribution of the chemist to radio has been the commercial production of a long list of alloys and new metals of remarkable properties, some of which have been mentioned. The incandescent light was the direct incentive for a substitute for platinum in the lead-in-wires, and also gave us tungsten whose extremely high melting point has caused it to supersede all its predecessors. In radio transmitting tubes, it was found that a metal of high melting point, with ability not to unduly absorb residual gas, is desirable. The answer of the chemist to this requisite is *molybdenum,* which is also used for the anchor wires in the tungsten light.

Although thorium had made radio a practical reality, the search for new and better ionizers was carried on assiduously. Eventually, it was noted that the alkali metals seemed preeminent in this respect, and a sodium tube particularly adapted as a detector has long been on the market. The very rare alkali metal *caesium* seems to have extraordinary powers of ionization; and it has been found possible to obtain effective results using a caesium-coated filament maintained at a barely red heat. The consequent saving in current is of course very large; and if only enough caesium can be found to go around, there is little doubt that we shall have tubes which will consume but a fraction of the current now used.

A patent has also been taken out for the utilization of the very new metal *hafnium* for this purpose, it being claimed that the emissivity or ionizing power is high. When it is realized that this metal, discovered in Copenhagen, was absolutely unknown three years ago, it can be seen that radio is up-to-the-minute in taking advantage of every contribution the chemist has made available.

THE "GETTERS"

The vacuums necessary in radio tubes are of an "order of emptiness" never before attempted in commercial production. It was necessary, not only to invent air pumps of an undreamed perfection, but also to call into play afterwards special chemicals selected for their ability to absorb and retain the last traces of any residual gas left by



This Remarkable Clock Does the work of 12 Clocks $3.75 POST-PAID

Tells at a glance correct time in all parts of the world

This new time device is being used by DX fans everywhere—Frame may be removed and clock inserted in panel of your receiver—This radio clock girdles the globe—overcomes confusion in bringing in distant stations—A glance tells you the time anywhere.
Most essential to the traveler in foreign countries or those motoring cross country—Guaranteed mechanically perfect. Shipped promptly, postpaid, on receipt of check or money order for $3.75. State time zone wanted.

SWIFT & ANDERSON, INC.
Successor to Henderson Brothers
Largest Importers of Field Glasses in America.
93 Federal Street, Boston, Mass.

RADIO BOOK FREE

64 pages full of opportunity. Your guide to what's right and standard in Radio; full explanation of liberal offer paying agents $60 to $100 a week and how to get latest radio goods at wholesale.

Big Money In Radio

We want live dealer and agents in every locality. Lifetime opportunity. This Book more than a catalog—shows big profit way to get into world's newest and richest field—make big money—turn full or spare time into cash. **Accept This Offer!** Write for FREE book. Lowest prices—make 40 to 60% every sale. 5-tube Coast to Coast Receiver $39.50 Retail. Sells on sight. Hundreds of such money makers. Write for special agent's wholesale prices. Newest sets, parts and accessories—tremendous saving and profit. Write for FREE book and amazing offers.

Standard Radio Company, 1410 Walnut St., Kansas City, Mo.

All Specified Parts FOR THE World's Record Super 9 and 10

Send for free catalog of all the parts needed for these marvelous receivers that have made four world's records. We have in stock complete sets of the exact parts used by the designer in his original receiver. Verification of records sent upon request. Write today!

THOR RADIO CO.,
318 Crilly Bldg. Chicago

Insure your copy reaching you each month. Subscribe to RADIO NEWS — $2.50 a year. Experimenter Publishing Co., 53 Park Pl., N.Y.C.

Is *actual* reproduction possible?

ALTHOUGH it is common to hear such claims as "Perfect Reproduction", "Absolute Perfection", "The Living Artist Brought Right into your Home" —in spite of these claims scientists have never boasted absolute *perfection* in radio reproduction.

Let us look at the facts.

At the broadcasting station the music of the violin, for instance, is changed into a radio wave, and is broadcast. It is then detected in your radio set and changed once more into an electric wave carrying the impulses of the music. This electric wave emerges from the detector tube not altogether perfect. However, it is so nearly perfect that radio science has turned its attention from the *broadcasting* and *detecting* phases of reproduction to *the audio amplifying* of the detector tube output.

Reproduction by good amplification has become the most important consideration in the art of radio. The amplifying transformers that were used in radio sets last year are definitely a thing of the past. Almost every set manufacturer has improved upon them. Some have adopted resistance coupling, others large size transformers, and some electric light socket power amplification.

Although these methods of amplification are an improvement, they do not and cannot give *perfect* reproduction, nor do they come as close to perfection as has now been made possible by the recently announced new principle of audio amplification.

The New Amplification

An entirely new system of amplification known as *Truphonic* has been developed. This system more nearly approaches actuality than any other yet devised. Scientific laboratory tests and tests before both the musically trained and the musically untrained ear establish this fact beyond question.

Unfortunately the Truphonic system was not developed in time to be generally used in this fall's production of radio sets — with the exception of a number of the makers of the more expensive sets who have a smaller production, and who were able to incorporate Truphonic amplification into their instruments.

But for radio listeners and lovers of fine music who want this most nearly actual of all reproduction *now* and immediately, the Truphonic Power Amplifier is provided in the simple, compact form shown below—*for instant attachment, without tools, and with no change whatever in your present radio set.*

Whether you bought or made your set this year, last year or five years ago, the Truphonic will give you finer reproduction than you can get in any other way—regardless of how much you can afford to spend.

The Truphonic Power Amplifier operates directly from the detector output. No transformers now in the set are utilized. This pure detector music in every note, tone, and shade and in considerably greater volume, is so beautifully and faithfully reproduced that you will find it as difficult to describe as it is for us to attempt to describe it to you.

The Truphonic with Power Tubes

Besides the fundamentally great improvement in reproduction that the Truphonic brings to radio in such a conveniently applied form, there is the added advantage that for those who want extreme volume without overloading the last stage tube, the necessary extra B and C battery connections for the use of power tubes are provided for in the attachment cord.

We have tried in this space to give you some idea of what you may expect from this new principle of audio reproduction that has come to radio. We realize that we have made some strong claims for Truphonic amplification, but we have made no claim that you will not find more than backed up when you have tried the Truphonic yourself.

We urge you to get the Truphonic *now*—so that you may begin immediately to have an altogether different kind of enjoyment of the splendid programmes that are coming to you over the air.

Your dealer has the Truphonic, or will get it for you.

ALDEN MANUFACTURING CO.
DEPT. K23, SPRINGFIELD, MASS.

TRUPHONIC

Power Amplifier

(Not Resistance Coupled)

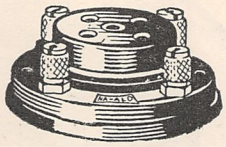
$20

Why the

NA-ALD

Silencer Socket

is essential to clean-cut reception



No. 481 XS

In many cases good clean-cut radio reception is decidedly hampered by the disturbing microphonic noises within the radio tubes—particularly the detector tube. These disturbing noises are caused by shocks and jars—very often slight—which come from various vibrations such as the vibration of the loud speaker, tapping the radio set itself, walking in the room or even street traffic. These vibrations cause the grid and the plate of the tube to vibrate in respect to one another.

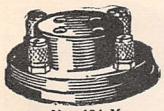
"Float" your tubes

In order to shield the tube against these shocks the Alden Silencer Socket has been designed. With this socket the tube is "cushioned" and "floated" absorbing all shocks in all directions—sidewise, up, down and pivotally. The marvellously balanced phosphor bronze springs which accomplish the "cushioning", form also the contacts for the tube and for the outside connections. This important point, among others, is fully covered by patents.

Contacts press firmly, strongly and flatly against the full length of the tube prongs. Special phosphor bronze, triple locked, contacts are held in constant tension insuring permanent quiet action. Solder lugs are provided for making connection either above or below the base panel. Or the lugs can be removed and the binding posts used. Round edge permits of mounting in any direction, and makes for a neat mounting on the base panel.

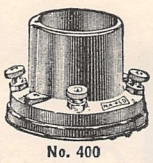
The Silencer Socket (for UV 201A and all UX tubes) is a superior socket which large production enables us to sell for 50c. At all dealers.

OTHER NA-ALD SOCKETS



No. 481 X

The Na-ald No. 481X socket is the popular priced universal socket for all UV 201A and all UX tubes. This socket is in great demand for amplifying tubes. The price is 35c.



No. 400

The Na-ald De Luxe Socket is designed for heavy duty service with the big, high voltage, expensive tubes. Triple lamination, dual-wire contacts will carry the heavy current used. The tube prongs and socket contacts can be self cleaned simply by a half turn rotation of the tube in the socket. Alden processed moulding assures the necessary mechanical and electrical strength. The De Luxe Socket is 75c at your dealer's.

ALDEN MANUFACTURING CO.

Dept. K23 Springfield, Mass.

the pump. These chemicals are often referred to as "getters." They are placed in the tubes before evacuation and take up any excess gas when the lamp filament is lighted for the first time. Among the materials used for this purpose have been *phosphorus, arsenic, sulphur, iodine* and their compounds, and metallic thorium, *zirconium* and *magnesium*. Cocoanut-shell charcoal, used in conjunction with liquid air, has proved a very good "getter," too. All these chemicals have helped to lower the cost of making radio tubes, since the attainment of a proper vacuum without their aid would be a costly process.

Although we have touched upon only the more obvious of the contributions of chemistry to radio, yet it must not be forgotten that, in a multitude of other ways less apparent, the great army of chemists has been steadily aiding and advancing the perfection of both receiving and transmitting. It is hoped that enough has been told to make clear to the casual reader that chemistry has indeed become the handmaid of the radio engineer.

Establishing Radio Standards of Frequency

(*Continued from page 667*)

To obtain the 18th harmonic the first I.F. circuits (L_1C_1 and L_2C_2) are adjusted again to 8 kc., and the second distorting amplifier now acts in its dual capacity, distorting and amplifying. The circuit L_3C_3 is adjusted to the first multiple of 8 kc. (second harmonic), that is, 16 kc. The alternating current of that frequency is a maximum in the L_3C_3 circuit, and the frequency meter is then adjusted to maximum value to give the position of the condenser for the 16 kc. value. The circuit L_3C_3 is then adjusted to the third harmonic, 24 kc., to 32 kc., etc., and the process repeated. The first I.F. circuits are then readjusted to give 9 kc., and multiples of this value obtained from L_3C_3 by successive adjustments. By changing the first I.F. circuits to values from 8 to 15 kc., and then adjusting L_3C_3 to successive harmonics of each intermediate frequency, points on the condenser for frequency values up to 400 kc. are obtained.

In the low-frequency part of the range 1 kc. represents a wide percentage separation of points on the calibration curve. To fill in this portion with known points the output from an accurately-calibrated 100-cycle (0.1 kc.) tuning fork was used in the same manner as the 1,000-cycle fork.

At 400 kc. the current produced by the harmonics becomes weak and the order of the harmonics hard to determine. The third distorting amplifier is then added, as shown in Fig. 3. The selector circuit, which is a commercial frequency meter, is inserted as indicated to assist in identifying the harmonics and to make the circuit more selective.

The first I.F. circuits are now adjusted to some frequency value, say 10 kc. The circuits L_3C_3, L_4C_4, and the selector circuit are then adjusted to some harmonic of 10 kc., say the 5th (50 kc.) which becomes the second intermediate frequency. The circuit L_5C_5 then has in it harmonics of the 50 kc. current (100 kc., 150 kc., 200 kc., etc.) These values may be obtained on the frequency meter by adjusting L_5C_5 to resonance with the various harmonics and noting the reading of scale for each. The condenser C_5 is tuned to give a maximum indication in the frequency meter for each harmonic. By using different values for first and second I.F., a large number of combinations can be formed. Harmonics of these various combinations are then obtained in L_5C_5 and

GIVE HEALTH

The most valuable and least expensive holiday gift that you can make

GIVE health as a Christmas present—to yourself, to every member of your family, and everybody in your community. You can! Buy Christmas Seals.

The work done by these tiny, mighty little seals has helped to cut the tuberculosis death rate by more than half.

Seal every parcel, letter, and holiday greeting with Christmas Seals. Give health—and feel the joy that comes with the giving of man's greatest gift to his fellow man—healthy happiness now and for years to come.

THE NATIONAL, STATE AND LOCAL TUBERCULOSIS ASSOCIATIONS OF THE UNITED STATES

Special Library of Information on

RADIO PATENTS and TRADE MARKS

JOHN B. BRADY

Patent Lawyer

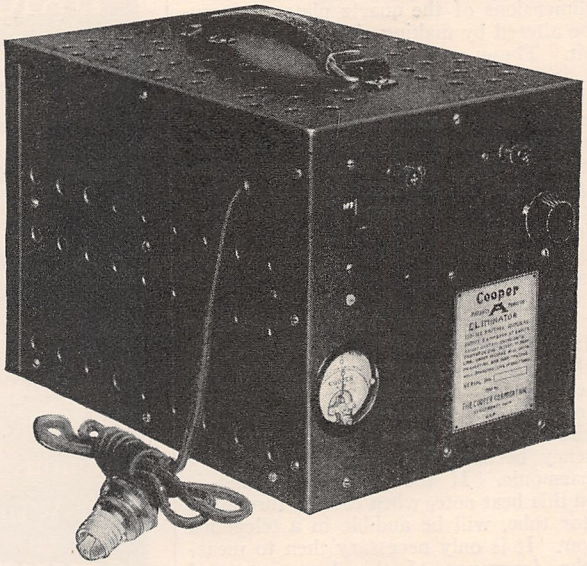
Ouray Building Washington, D. C.

Cable address: RADIOPAT

Telephone: Main 4806

Insure your copy reaching you each month. Subscribe to RADIO NEWS — $2.50 a year. Experimenter Publishing Co., 53 Park Pl., N. Y. C.

Cooper "A" Eliminator



DEALERS—JOBBERS: The Cooper "A" Eliminator is the only device of its kind on the market. It is new in principle — has no competition. Limited distribution and full protection to trade outlets insure legitimate profit. Write for full particulars of our exclusive proposition.

Actually *Eliminates* the "A" Battery!

Operates Any Receiver *Direct* from the house current! No batteries to water---needs no attention of any kind!

At last the storage "A" battery, with its messy watering and charging, has been totally eliminated as a radio necessity.

Now any set can be operated direct from the light socket. The Cooper "A" Eliminator actually eliminates the "A" battery—creates filament current direct from the house lighting system. The Cooper "A" Eliminator requires no attention of any kind — no batteries to water or bother with — no acids or liquids to replace—plug it into the light socket as you would an electric iron or toaster. A simple throw of a switch and your current is on—tumble back the switch and the current is off.

Not a Power Unit — Employs No Trickle Charger

The Cooper "A" Eliminator operates purely on a rectification and filtration principle. It delivers up to 2½ amperes of noiseless, distortionless filament current that works wonders with your receiver. The Cooper "A" Eliminator is designed to operate on any make or type of receiver using up to ten 6-volt tubes. It consumes current only while you use the set.

Send for This Free Booklet!

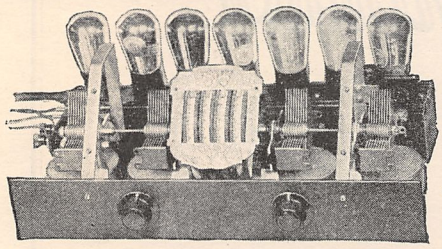
We have prepared a very complete folder describing the Cooper "A" Eliminator and the new principle upon which it is built. A letter or post card will bring it to you free.

Good radio dealers in most cities have the Cooper "A" Eliminator now on display. Price $87.50 (tubes extra); slightly higher west of the Rockies.

THE COOPER CORPORATION, *Radio Division, Dept. N* **CINCINNATI, OHIO**

Founded 1904 — Factories, Cincinnati and Findlay, Ohio

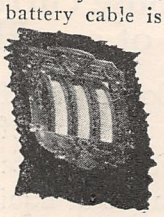
Now you can build a really *professional* radio set



To build a really professional looking and efficiently operating radio set here are two new and important construction units.

The Truphonic Power Amplifier, more fully described on another page of this issue, provides by far the finest type of audio amplification so far developed. For the set builder the Truphonic may be had in a Catacomb Assembly which gives you a complete unit containing the following: Complete Truphonic audio amplifying system including an output unit to protect the speaker from burning out and demagnetization, sockets with attached leads for the tuning and detector end of the set.

The illustration shows how neatly this Catacomb Assembly houses all of these elements and how compactly it fits behind the tuning control. No holes to drill, no apparatus to mount. Short, direct leads with a minimum of soldered connections. This unit may be arranged in a hundred different ways to match all the requirements of every circuit and set design. A six foot battery cable is included, in which provision is made for the extra B batteries and C batteries for the use of power tubes.

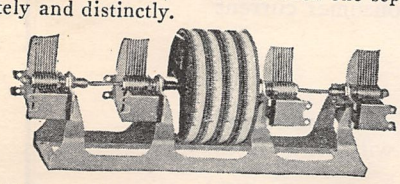


The Truphonic Assembly is provided in two models, one for 6 tubes, $20, and one for 7 tubes, $22.

NA-ALD

Localized Control Tuning Unit

The Na-Ald Localized Control (Trademark Reg. U. S. Pat. Off.) Tuning Unit (Quadruple model shown) is a boon to the set builder—a great advance in multiple condenser construction. It can be used with any form of radio frequency coils, and gives you simple control under the finger tips of one hand, enabling you to tune all the condensers at once, or to tune each one separately and distinctly.



These advanced Na-Ald Localized Control Tuning Units are provided in several models (all are of .000375 capacity unless otherwise indicated). Double $8., Double (.0005) $10., Triple $10., Quadruple $15., Double with tickler control $10.

With each unit is included the handsome panel plate shown above.

Your dealer has these Na-Ald advanced construction units, or can get them for you.

ALDEN MANUFACTURING CO.
Dept. K23 Springfield, Mass.

they are transferred to the frequency meter as before. More harmonics than are necessary can be obtained, and the circuit is easily operative up to 4,000 kc. (75 meters).

THE PIEZO-ELECTRIC STANDARD

Another standard of radio frequency used by the Bureau of Standards is the *piezo oscillator*. A piezo oscillator is an electron tube circuit controlled by a quartz plate; and will give one frequency which is determined by the dimensions of the quartz plate. This frequency can be changed only by changing the dimensions of the quartz plate, and cannot be altered by making changes in the tube circuit. These oscillators give a very constant frequency value and, since as yet the value of the frequency cannot be calculated accurately from physical data, it is desirable to calibrate them directly against the standard tuning fork. Since these piezo oscillators give fixed frequencies and the harmonic amplifier can give only multiples of the tuning fork frequency, it is unlikely that a frequency from the harmonic amplifier will be the same as the frequency of the piezo oscillator.

If the current from the piezo oscillator and from a harmonic of the tuning fork, obtained from the harmonic amplifier, are "picked up" in a receiving set coupled to both of them, a *beat note* will be produced in this circuit which is equal to the difference in frequency between the piezo oscillator and the harmonic. If the proper harmonic is chosen this beat note, when carried through a detector tube, will be audible in a telephone receiver. It is only necessary then to measure the frequency of this beat note and either add or subtract it to or from the value of the harmonic to determine the piezo oscillator frequency. For example, suppose the piezo oscillator has a frequency of approximately 80.5 kc., and the harmonic amplifier is set to produce the 80th harmonic of the tuning fork, 80 kc. A beat note of 500 cycles will then be obtained between the two sources. To find the exact frequency value of the piezo oscillator, it is necessary to find out whether or not this beat note is exactly 500 cycles. To do this an auxiliary device called a sonometer is used.

THE SONOMETER

The sonometer, which is shown in Fig. 5, is simply a steel wire stretched across two knife edges. The distance between the knife edges may be varied and measured. A stretched wire will give a natural frequency value which may be calculated by the formula

$$\text{Frequency} = \frac{1}{2 \times \text{length}} \sqrt{\frac{\text{Tension}}{\text{mass per unit length}}}$$

If the proper tension, length, and mass per unit length are selected, any value of frequency within the audible range may be obtained. A single steel piano wire is used, and only the tension and length varied, to give a frequency range from 100 to 3,000 cycles, which is sufficient for the purpose.

Suppose the wire is adjusted to give a certain frequency. If a vibration of the same frequency is applied to the wire it will start vibrating; that is the vibrating wire will be in resonance with the source of vibration. If the frequency of the source is changed, the length of and tension on the wire can be changed to restore the wire to resonance. The wire used in this sonometer is steel and consequently will be attracted by a magnet.

The beat note frequency which it is desired to measure is carried through a telephone receiver, from which the diaphragm has been removed and the telephone magnets exposed. This telephone magnet is brought up underneath the steel wire and periodically attracts it at the frequency of the beat note. The length of the wire is then adjusted until the natural frequency of the wire is the same as the frequency being carried through the mag-

New!

Crackle Surface ACE HARD RUBBER PANEL

of highest insulating efficiency with a distinctly attractive surface finish.

In regular ready-cut sizes:

7x10 7x18 6x26
7x12 7x21 7x30
7x14 7x24 .....

Popular prices. All dealers.

Made by the makers of the famous RADION PANELS.

Write for price list.

American Hard Rubber Company
11 MERCER ST., NEW YORK

50% BETTER Reception with EFFARSEE Antennae *or Your Money Back!*

That guarantee shows how certain we are that the wonderful new EFFARSEE Antennae will increase the power, range and selectivity of your set. The scientific design of this marvelous device, built on an entirely new principle with two specially made condensers, practically eliminates static and interference.

Don't Imperil Your Life

Why clutter up your home with ugly outside wires or masts? Why take a chance of death by a fall when erecting or repairing an outside aerial? Why deliberately attract the deadly lightning that may kill your whole family and burn your home? Just buy your EFFARSEE Antennae, shove it under a rug or put it in the attic, and enjoy perfect safety and get 50% better reception. No trouble—installed in 30 seconds—lasts forever. Radio manufacturers find it ideal for testing sets. Approved by Radio News, Popular Science, Popular Radio and other prominent Radio Magazines. Thousands of enthusiastic users.

Send No Money

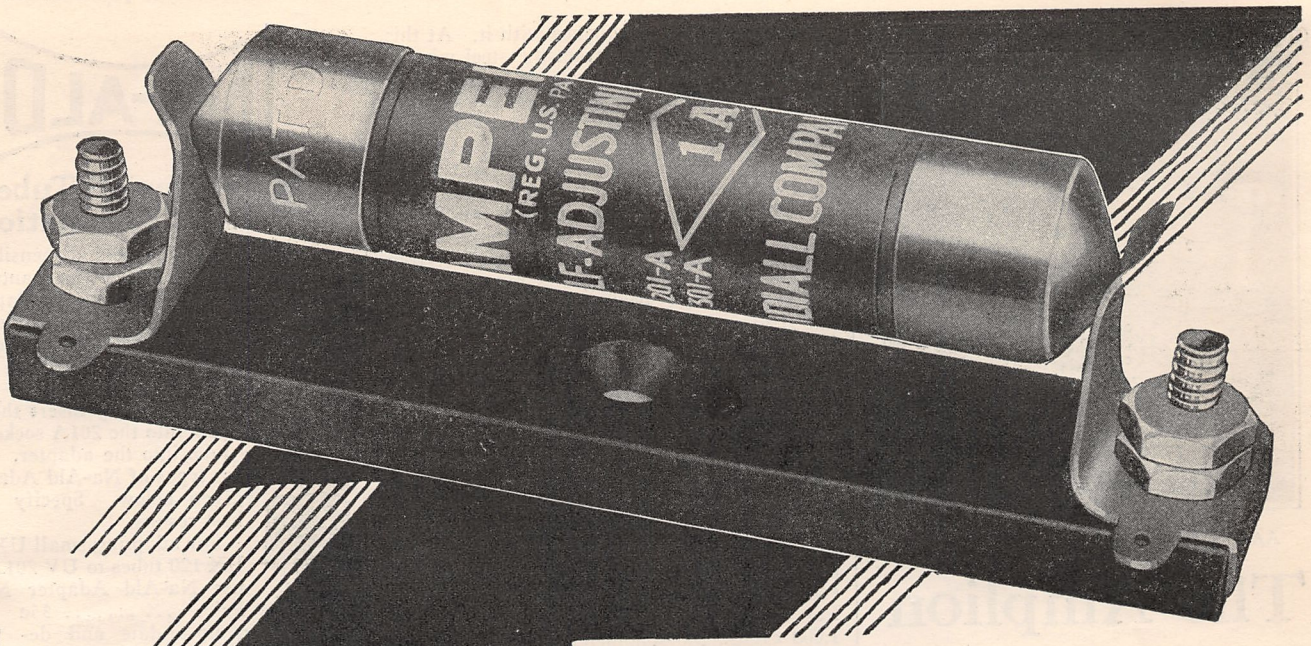
Order your EFFARSEE Antennae today, at the special price of $4.00. If it does not improve the performance of your set at least 50%, return it and we will refund your payment in full. Send no money—just your name and address. We'll send your EFFARSEE Antennae at once, and you can pay $4.00 to the postman on delivery. Remember, you take ABSOLUTELY NO RISK.

Dept. 25 FISHWICK RADIO CO., Cincinnati, Ohio

Potter Condensers

Potter condensers, American made of highest quality materials to full capacity, build the best Socket Power Devices, Power Amplifiers, Impedance Amplifiers. And they are best for Filter Uses, Rectifiers, By Pass, and Blocking D.C. All types and sizes.

POTTER MANUFACTURING CO.
North Chicago, Illinois

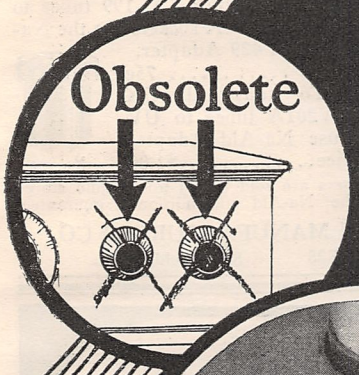


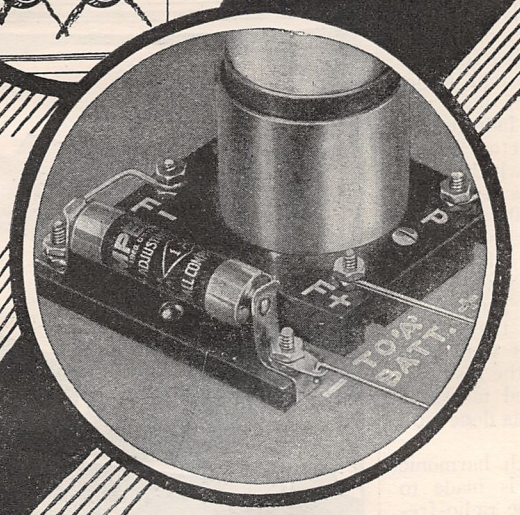
Why your set needs AMPERITE

Because quality of reception without distortion, also long tube life necessitate that delicate and self-adjustable filament control which only AMPERITE can give you.

AMPERITE eliminates hand rheostats, simplifies set-wiring and abolishes all tube troubles.

Uniformly successful performance for more than 5 years in every type of circuit has proven AMPERITE to be ***the only perfect filament control.***





$1.10 complete with mounting
[In U. S. A.]

Universally accepted as the best filament control by leading radio engineers, AMPERITE is recommended by them as standard equipment in every popular construction set. For instance:—

HAMMARLUND-ROBERTS "Hi-Q"	L-C 27
Popular Science Monthly's	HENRY-LYFORD RECEIVER
POWERFUL 5 TUBE SET	VICTOREEN SUPER
KING EQUAMATIC	BROWNING-DRAKE
INFRADYNE	BEST'S SUPER
DIAMOND OF THE AIR	INTERFLEX

and many others

FREE Write for "The Radiall Book", containing 24 pages of the latest popular hook-ups and valuable information for the set-builder. Sent free on request to Dept. R.N.-12.

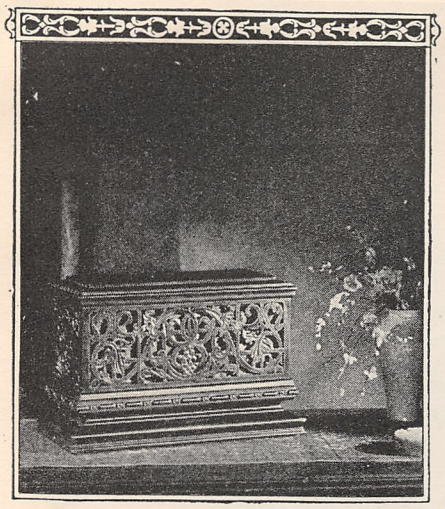
Radiall Company

50 Franklin Street **New York City**

AMPERITE

REG. U.S. PAT. OFF.

The "SELF-ADJUSTING" Rheostat



AA18 .....$45

The Amplion Patrician

—a perfect gift for the radio enthusiast—reproduces with exceptional richness those delicate overtones which give to music its timbre, its true character and tonal beauty.

THE Patrician is the most recent development of the world famous Amplion air-column type of radio reproducers. It encloses a remarkable 48″ column in a richly carved mahogany cabinet, 18″ x 12″ x 9″, that harmonizes perfectly with modern, luxurious home appointments.

Acoustically, the Patrician is non-directional. To the notable Amplion sensitivity and clarity it adds a new softly diffused mellowness of tone that makes this instrument the choice of the connoisseur wherever heard.

AMPLION CONE

A time-perfected Amplion development; clear, loud, and of inexpressibly pleasing tone. Mahogany cabinet, 14″ x 14″ x 9″.

AC12 ..... $30

AMPLION DRAGON

This famous model is adopted as standard for tests and comparisons by leading radio engineers, wherever broadcasting exists.

AR19 ..... $42.50

Write for the interesting Amplion Booklet

THE AMPLION CORPORATION OF AMERICA

Suite S, 280 Madison Avenue, New York City

The Amplion Corporation of Canada Ltd., Toronto

AMPLION

net coil; that is in resonance with it. At this time the magnet will attract the steel wire at a frequency equal to the natural frequency of the wire, and the wire will be set in vibration. This point will be made evident by a sound being produced by the wire; but as it may be too weak to hear easily, a very light paper rider is put on the wire. When the wire starts to vibrate the rider starts to shake and may even be thrown off. The frequency of this vibration can then be calculated from the formula given above, and represents the frequency of the beat note, which must be added to or subtracted from the value of the harmonic used.

To determine whether this beat frequency should be added or subtracted to the harmonic frequency, two or more harmonics are used which, when taken together, will show what the value must be. The piezo oscillators can likewise be given a fairly accurate calibration, by means of a previously-calibrated standard frequency meter, so that it is not always necessary to use several harmonic points. It is not necessary that the sonometer give a high degree of accuracy. For example, working with a beat note of 1,000 cycles, the sonometer may have an error of 0.5%. At a radio frequency of over 100 kc. this would represent less than 0.005% error in the radio-frequency determination, which is less than other errors incidental to the calibration. By taking the two harmonics, one above and one below the frequency of the quartz plate, even some of this small error can be eliminated.

COMPARISON OF TUNING FORKS

This apparatus may also be used to compare two audio frequency sources, such as two tuning forks of different frequencies. We wished to compare the 1,025-cycle tuning fork with one having a frequency of 100 cycles per second, which was used to obtain some of the low frequency values. The frequency of this tuning fork could be observed continuously and very accurately. A beat note was obtained between a harmonic from the output of the 1,025-cycle tuning fork and the fundamental of a very constant radio-frequency generator. This beat note was reduced to zero, this point being indicated by means of a sensitive milliammeter, in the plate circuit of a detector tube, which would vibrate if the beat note had a frequency other than zero and less than 20 cycles per second. Beat notes above 20 cycles could be heard in a pair of telephones. The output from the 100-cycle tuning fork was carried through the harmonic amplifier, and a harmonic selected near the value of that of the generator. The two frequencies were then combined in a tuned circuit, and the resulting beat note detected, amplified, and measured by means of the sonometer, as was done with the piezo oscillator.

To illustrate, suppose the 99th harmonic of the 1,025-cycle tuning fork is made to beat with the fundamental of the radio-frequency generator. The generator then gives a frequency of 101,475 cycles. By means of the harmonic amplifier the 1010th harmonic of the 100-cycle tuning fork is obtained. The two are combined in a circuit and a beat note is produced and carried through the receiver magnet of the sonometer. By adjustment of the sonometer it is found that the wire vibrates at a value corresponding to 475 cycles. This then shows that the harmonic of the 100-cycle tuning fork has a frequency of either 101,000 cycles or 102,950 cycles. By using another harmonic it is found that the value must be 101,000; that means that the fundamental of the tuning fork is exactly 100 cycles. Several combinations of harmonics were used to obtain a mean value.

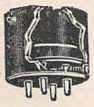
Since the frequency of the 100-cycle tuning fork was observed by means of an entirely independent means, a check on the original calibration of the 1,025-cycle tuning fork was obtained.

NA-ALD

Adapters for all Tube and Socket Combinations

Na-Ald Adapters are indispensible to the set owner and set builder who wants a simple and instantaneous means of adapting any particular type of tube to the particular type of socket that is used in his set. For instance, if your set is now equipped with standard 201A sockets, and you want to use the small UV 199 type tube, simply insert the Na-Ald Adapter No. 429 into the 201A socket and insert the 199 tube into the adapter.

The various types of Na-Ald Adapters are given below. Specify them for best results.

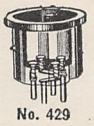


No. 419X

For adapting small UX 199 and UX 120 tubes to UV 201A sockets, use Na-Ald Adapter No. 419X. Price 35c

No. 421X

To bring up-to-date and decidedly improve the Radiola III and IIIA and similar sets employing WD 11 Tubes, use Na-Ald Adapter No. 421X. Price 75c



No. 429

For adapting UV 199 tubes to standard 201A sockets use the Na-Ald No. 429 Adapter. Price 75c

No. 999

To adapt all UX tubes and UV201A tubes to UV 199 sockets use Na-Ald Adapter No. 999. Price.....$1.00

Na-Ald Adapters are sold by all good radio stores and carry the Na-Ald unconditional guarantee.

ALDEN MANUFACTURING CO.

Dept. K25 Springfield, Mass.

AEROVOX

"Built Better"

FIXED CONDENSERS

are Specified in

LC-27	by L. M. Cockaday
Diamond of the Air	" Herman Bernard
To be announced soon(?)	" John Rider
Raytheon "B" Eliminator	" Raytheon Mfg. Co.
Ultradyne	" R. E. Lacault
To be announced soon(?)	" R. E. Lacault

AEROVOX fixed condensers have been approved by M. I. T. and Yale Universities.

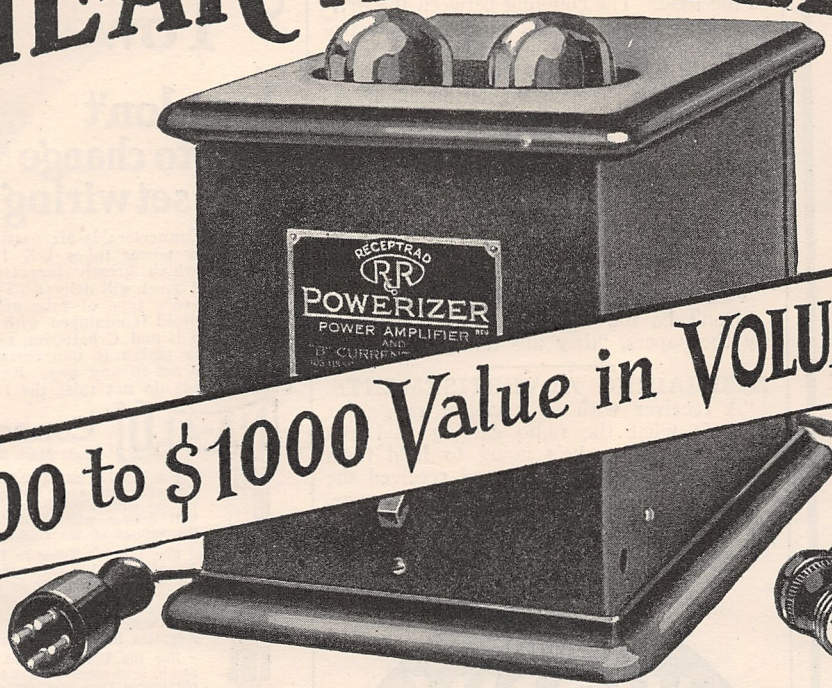
AEROVOX WIRELESS CORP.

489-491-493 Broome Street

New York

HEAR IT—and BELIEVE!

Ask Your Dealer to Demonstrate It



$300 to $1000 Value in VOLUME and TONE for $49.50

POWERIZER

REG.

Combined "B" Eliminator and Power Amplifier

RADIO amplification and "B" Battery elimination are admitted to be the only two really big developments in Radio during the last five years. Powerizer now, in one revolutionary stroke, combines both in one unit, so that by merely attaching this unit, you can secure all the tone and volume advantages offered up to this time only in the newest power sets costing from $300 to $1,000.

With Powerizer attached to your set, former lifeless and colorless radio sounds are changed to vibrant brilliancies that literally transport you to the broadcast studio. Yet Powerizer costs you no more than a good "B" Battery eliminator ALONE.

Supplies up to 130 volts "B" power for set, 400 volts for power tube, proper bias eliminating "C" batteries, and "A" voltage for last tube. Operates directly from any electric light socket and pays for itself quickly in "B" Batteries saved.

To know the Powerizer fully and to appreciate it, you must HEAR it. If you want Radio's most perfect reproduction in your own home, on your own present set—go to the nearest Powerizer dealer today and ask for a demonstration.

Biggest Hit Ever Known in Radio

Write for Details, Diagrams etc. NOW!

DEALERS! Are you missing this unusual opportunity? Become a Powerizer dealer now. Be able to demonstrate this unit and reap the big sales that Powerizer dealers are enjoying. Write or wire today.

Modernizes Your Set Instantly

RADIO RECEPTOR CO., 106 Seventh Ave., New York

Gem Tubes

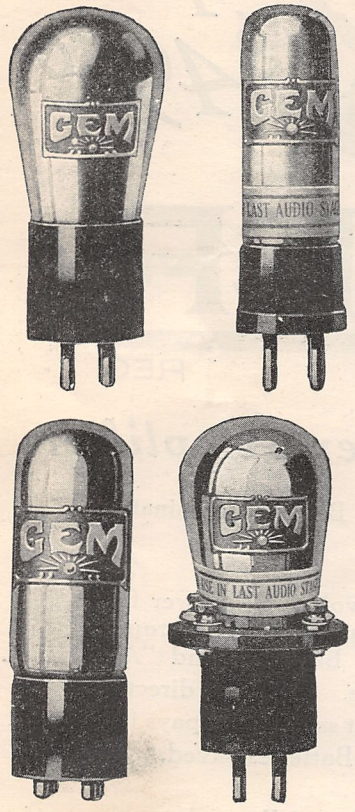
$1.00

The Biggest Dollar's Worth in Radio

The Perfect tone and clearer powerful volume of Gem Radio Tubes makes them indeed worthy of their name.

Equip Your Set With Gem Tubes

Why pay more?—Gem Tubes are built to give greater distance, clearer volume and finer tone. Every tube guaranteed to give satisfaction.



A Complete Line of Radio Tubes

There's a Gem for every Radio Receiver and every Radio Need.

Gem Dollar Line:—

401A	499
499A	x499

Gem Power Tubes at Popular Prices

400A	420	412 Adapter
412	471	471 Adapter
416B	410	413
42	420A	402

M U—X 29-19-9 Dry Cell
M U—X 30-30-6 Wet Cell

Write for information about our special Kit that settles tube problems

ASK YOUR DEALER TO SUPPLY YOU

GEM TUBE COMPANY

16 Hudson Street, New York City
108 West Lake St., Chicago, Ill.
Lafayette Bldg., Detroit, Mich.

A standard tuning fork is shown, in Fig. 6, in its mounting with the driving coils in place. The necessary electron-tube circuit is attached to the four binding posts shown on the base. The coupling between the driving circuit and the fork is entirely electromagnetic, and the tuning fork controls entirely the frequency of the alternating current produced. The circuit itself cannot generate ("oscillate").

The harmonic amplifier has been in use for nearly two years and it has been found to be accurate and very convenient to use. By means of it any radio-frequency standard can be calibrated directly against standard tuning forks.

VERY MUCH SO—SOMETIMES

"Don't be too hard on the announcers," say the papers, "they are trying."

MISLEADING ADVERTISEMENTS

"A receiver with an excellent range for $15," is what the radio catalog said and Uncle Silas says he's going to hold them to it. He sent his $15 in and received the radio all right but no sign of the range. If they don't send that range mighty soon he's going to demand his money back.

—*Contributed by William G. Mortimer.*

Station
WRNY
NEW YORK
373.8 Meters - 802 kilocycles
is owned and operated by the publishers of this magazine
Our Editors will talk to you several times every week-
See your Newspaper for details
TUNE IN ON WRNY

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of Radio News, published monthly at New York, N. Y., for October 1, 1926.

State of New York, County of New York, ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the publisher of Radio News, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, to wit:

1. That the names and addresses of the publisher, editor, and business manager are:

Publisher and Editor, Hugo Gernsback, 53 Park Place, New York, N. Y.

Business Manager, R. W. DeMott, 53 Park Place, New York, N. Y.

2. That the owners are:

The Experimenter Publishing Co., Inc., 53 Park Place, New York, N. Y.

Hugo Gernsback, 53 Park Place, New York, N. Y.
Sidney Gernsback, 53 Park Place, New York, N. Y.
R. W. DeMott, 53 Park Place, New York, N. Y.
H. W. Secor, 53 Park Place, New York, N. Y.
Dr. T. O'Conor Sloane, 53 Park Place, New York, N. Y.
Mrs. Catherine Major, 545 W. 158 St., New York, N. Y.
M. M. Finucan, 720 Cass Street, Chicago, Ill.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

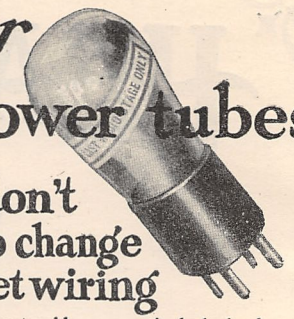
HUGO GERNSBACK,

Sworn to and subscribed before me this 21st day of September, 1926.

JOSEPH H. KRAUS, Notary Public.

(SEAL) (My commission expires March 30, 1927).

For Power tubes



You don't have to change your set wiring

Na-Ald Connectoralds are particularly in demand for the new power tubes UX 171, UX 112, and UX 120, which greatly increase the undistorted volume that a set will deliver. There is a Connectorald for every type of tube and set. Each type of Connectorald is equipped with cables to connect to the extra B and C batteries, necessary for power tubes. This makes it unnecessary to change the wiring of a set in any way. Except where noted, Connectoralds do not raise the tube in the socket

NA-ALD Connectoralds
Trade Mark Reg. U. S. Pat. Off

No. 112

For UX 171 and UX 112 Tubes, Na-Ald 112 Connectoralds are recommended for maximum volume with storage battery sets. These tubes will deliver without distortion several times the volume of the regular 201A. Price $1.50.

No. 120

For UX 120 Tubes in UV 201A sockets, the Na-Ald No. 120 Connectorald should be used. To convert a storage battery set to dry batteries with ample loud speaker volume, use a UX 120 tube in the last audio stage with the 120 Connectorald and UX 199 tubes with 419X Adapters in the other sockets. Price $1.25.

No. 920

For the UX 120 Tube in UV 199 sockets, ample loud speaker volume without distortion is obtainable from any set equipped for UV 199 tubes by means of the UX 120 or equivalent tube, with the Na-Ald No. 920 Connectorald. The tube is raised slightly, but provides for its use in most sets with limited headroom. Price $1.25.

No. 420

For UX 120 tubes in the UV 199 sockets of the Radiola Superheterodyne Semi-Portable, and Radiola Super VIII. These excellent Superheterodynes will deliver ample volume for loud speaker operation when equipped with the UX 120 used with the Na-Ald No. 420 Connectorald. Price $1.25.

ALDEN MANUFACTURING CO.
Dept. K23 Springfield, Mass.

LYNCH METALLIZED FIXED RESISTORS

ARE WARRANTED—

Absolutely Noiseless
Permanently Accurate
Dependable!

Write us!

ARTHUR H. LYNCH, Inc.
Manufacturers of Radio Devices
Fisk Bldg., Broadway & 57th Street
New York, N.Y.

MEMBER RMA

American Radio Now—
Lowest Wholesale Prices on **RADIO!**

AMERICAN AUTO & RADIO MFG. CO.

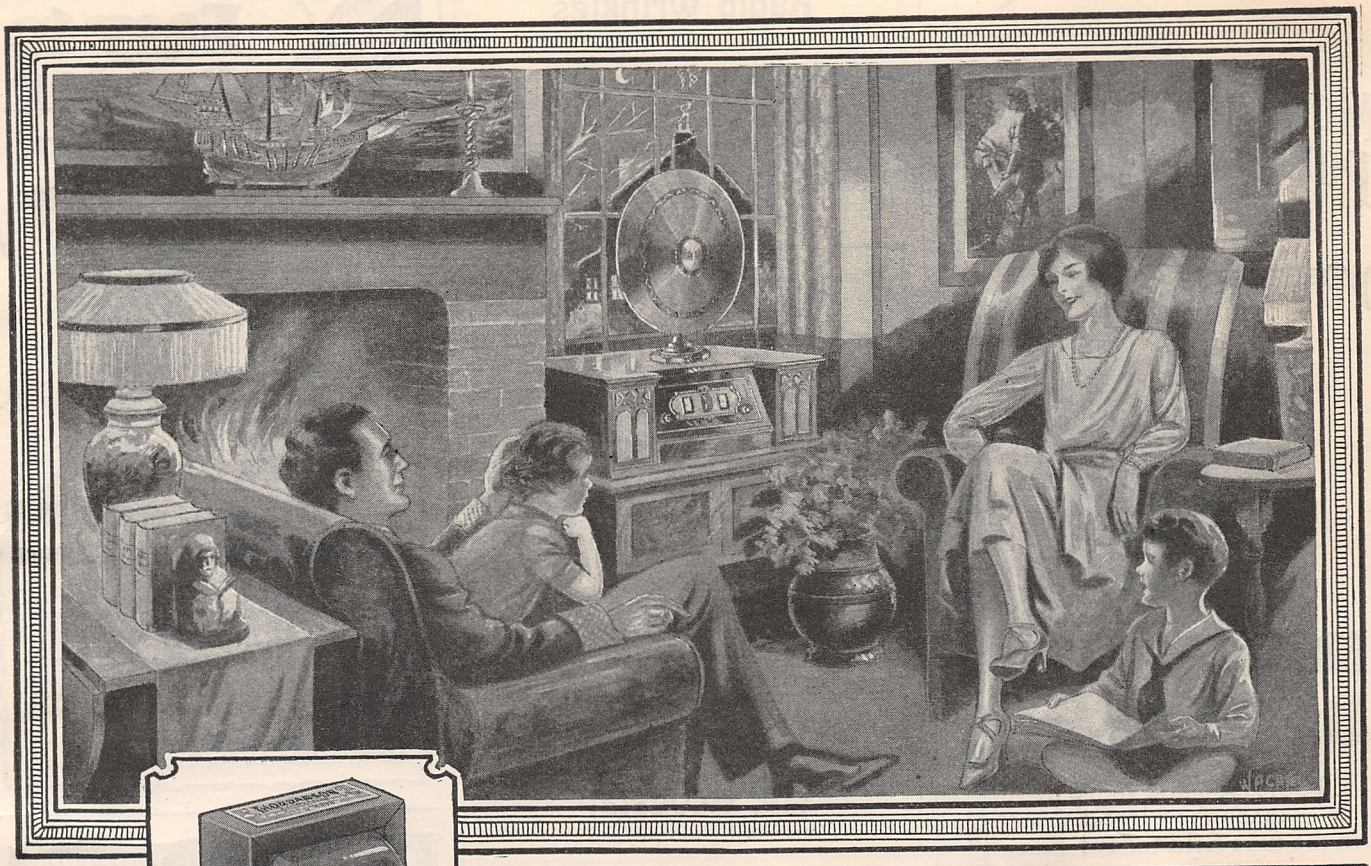
BIG NEW 1927 CATALOG-FREE

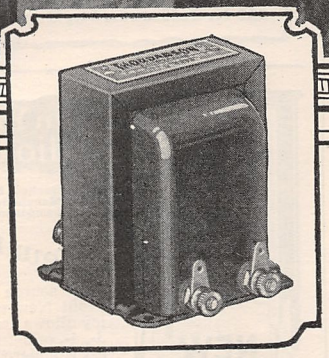
Dealers, Agents, Set Builders—get our big 1927 Catalog—225 nationally advertised lines. Low money-saving prices! Largest, most complete stock. Radio's latest developments. It's FREE—send for your copy now.
AMERICAN AUTO & RADIO MFG. CO., Inc.
1433 McGee Street, Kansas City, Mo.

You can be quickly cured if you

STAMMER

Send 10 cents for 288-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering 20 yrs. **B. N. Bogue, 6962 Bogue Bldg., 1147 N. Ill. St., Indianapolis**





THORDARSON

R-200
AMPLIFYING TRANSFORMER

Supreme in MUSICAL PERFORMANCE!

THE secret of good reception lies not in attempted correction of the deficiencies of *poor* broadcasting, but in faithfully reproducing the programs of the *better* stations.

Thordarson transformers employ neither a "rising" or a "falling" characteristic for corrective purposes. They are designed to give, as nearly as possible, equal attention to all notes.

The majority of leading quality receivers are equipped with Thordarson transformers—a substantial evidence of the musical supremacy of Thordarson amplification.

ZENITH
SPARTON
Neutrowound
Pfanstiehl
The Wells BEAR CAT
KENNEDY
MU-RAD
OZARKA
Valleytone
RADIODYNE
Howard
Murdock
Deresnadyne
EAGLE
ARGUS
RADIO MASTER
AUDIOLA
HARTMAN
Buckingham
Mohawk
ALADDIN
Perlesz
Signola
Heraldyne and many others

Standard on the Finest

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer Specialists Since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Huron and Kingsbury Streets — Chicago, Ill. U.S.A. 3445

More Power!

POWER DETECTOR

POWER—and more of it—that's the biggest thing in the tube field today! Sonatron's famous power tubes are giving new life to thousands of sets—and new enjoyment to thousands of set owners. The very next thing you should do is to buy this remarkable power detector—and hear the amazing improvement in reception which it brings! It's one of a family of 25 distinct types—the world's largest tube line!

SONATRON-ize *your* set!

The
Sonatron Amplifier
with 3 Red, White and Blue
Matched Power Tubes

Adds three stages of amplification to any set, even a crystal. One connection, made in a moment, and you have this source of amazing power and tone. Adds beauty to your set, and makes your batteries last longer. For dry-cell or storage battery sets, $20 complete. At your dealer's.

SONATRON TUBE CO., Chicago, New York, Newark, N. J., Detroit
Windsor, Ont., Canada

SONATRON

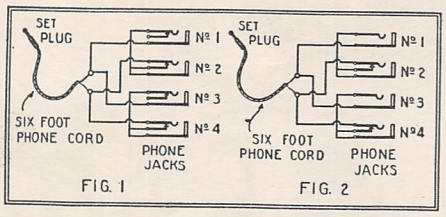
Nationally Advertised SONATRON *Standard Quality*
Trade Mark

Manufacturers of the WORLD'S LARGEST TUBE LINE

Radio Wrinkles

(*Continued from page 675*)

phones of the same make are to be used, they should be plugged-in in the order indicated. This puts head phones No. 1 and 2 in series, and No. 3 and 4 in series, and the two sets of head phones in parellel. If two pairs of head phones of different makes



Where a number of headphones are to be used in conjunction with a receiving set it is not a good idea to connect them all in parallel or all in series. One or the other of the arrangements shown above should be used.

are to be used, one pair should be plugged in the No. 1 jack, and the other in No. 3. If the two pairs of phones are alike, they should be plugged in No. 1 and 2, or else 3 and 4. In Fig. 2 is shown the same circuit but using different types of jacks.

Contributed by Charles F. Felstead, 6CU.

The Acoustat

(*Continued from page 671*)

energy in order to avoid reducing the signal also.

SPATIALIZER TECHNIQUE

The best place to excite the 1,365-cycle signal stationary wave is at points 1 and 5 (Fig. 2.) These are 1/6 wavelength from either end of the spatializer, S. If we place the input air coupler 12 at this point the 1,365-cycle tone will be strongly developed. In fact we can use a "Y-tube" and lead the sound in at points 5 and 1 simultaneously, cancelling out to some extent the 910-cycle tone.

We now pick up the 1,365-cycle signal tone at points 3 and 6 with the "pick-ups" 11 and 10. Here the 910-cycle tone has least motion in the air particles, but the air pressure variations, which transmit the wave through the "pick-ups" and which would blow out a candle held at 0-3 and 6, are a maximum.

Hence we put a "Y-tube" as an output from points 3 and 6 to act as a "counterphase" tube.

WHAT IS A COUNTERPHASE TUBE?

A "counterphase" tube simply means that the phases at points 0 and 3 or 3 and 6 are opposite. Hence the 910-cycle static tone is "choked out" by the time it reaches the outlet.

The 1,365-cycle signal tone has a phase difference of 270 degrees or 90 degrees between points 3 and 6 and hence is not changed by the counterphase tube.

Thus the most difficult step was to convert the static noise, for this particular arrangement into 666 cycles and to make the beat note take a pitch of 1,000 cycles per second. When this was done a microphone or other sound-converting device was actuated by the above pick-up tubes leading to the stationary wave chamber. This microphone was in some cases placed inside of the stationary wave chamber and reamplified the signals on a 3-stage A.F. amplifier to 200 or 2,000 audibility, as desired.

In other cases a counterphase tube was used to supply the sound converter. Such a

Easy to Solder This New Way

Indispensable for all soldering work. Simple — Speedy — Economical

Pat. Applied For

$3.25
COMPLETE

Press-to-Feed Electric Soldering Iron

One hand does the work of two. Speeds up radio set construction. Far better than a blow torch. Solder will not melt until it reaches soldering point. Porcelain insulations prevents heat from entering handle.

Representatives—Dealers—Jobbers

This newly invented electric soldering iron offers big money making opportunity. Order a sample today $3.25. Discounts in quantities on request. Write to.

ILLINOIS STAMPING & MFG. CO.
220 N. Jefferson St., Dept 13, Chicago

Own Your Own Radio Business

Backed by responsible Radio Manufacturer who makes every component part of the famous

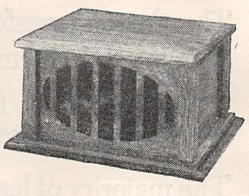
New PREMIER Console

One source of supply—one profit. New, revolutionary policy allows trade-in of any old 3-, 4-, or 5-tube radio on newest Premier Console Radio at lowest wholesale distributor's price. Over 21 years' experience making precision electrical and radio apparatus has produced dependable Premier efficiency and quality, fully covered by our guarantee. Send at once for complete details of

Premier Distributor's Franchise
Beat the other fellow to it!

PREMIER ELECTRIC COMPANY
827-TX Premier Bldg. Grace at Ravenswood Chicago, Illinois

NOT A LOUDSPEAKER
But a
QUALITY REPRODUCER

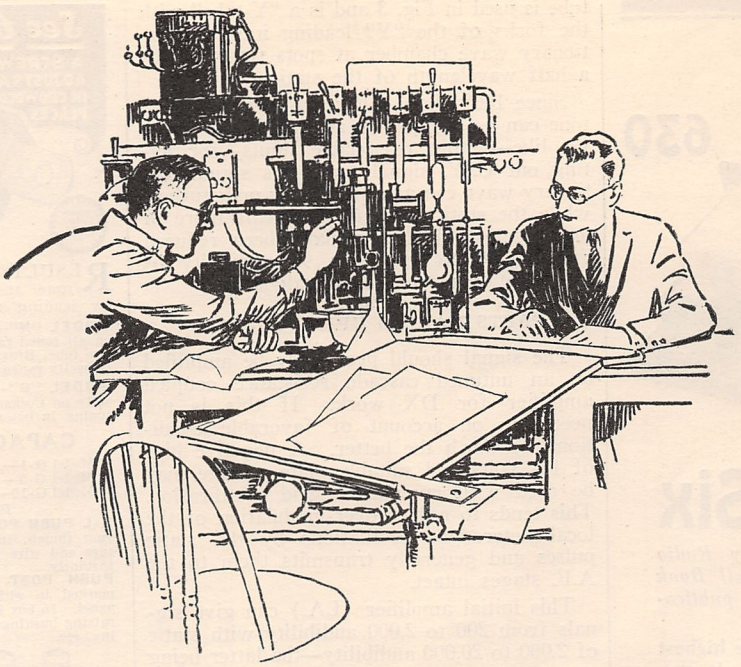


Our patented tonal chambers reproduce microfonic vocals and orchestrations with mellowness, clarity and perfect resonance.

A new principle invented by a master craftsman of acoustics, the science of sound.

$18.00 WALNUT and MAHOGANY FINISH
Write us direct
ARTHUR BOLTEN CO., 1924 19th St., Santa Monica, Cal.

1927 CATALOG JUST OUT!
SEND FOR YOUR COPY
RANDOLPH RADIO CORP.
180 N. UNION AV. Dept. 2 CHICAGO, ILL.



A $20,000,000 IDEA

TEN YEARS ago Charles Grover Smith began the intensive study of the possibilities of handling electrical power by gaseous conduction. With the resources of the Raytheon Research Organization behind him, he produced the Raytheon Rectifier, giving for the first time full wave rectification with simplicity, long life, and absolute reliability, and making possible in the one year since its introduction, a business in Raytheon-equipped B-Power units of approximately $20,000,000.

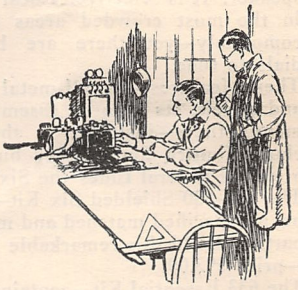
Raytheon has many ideas. For their development Raytheon maintains a Research Organization housed in a separate building, and with a staff headed by such men as Mr. Smith, Dr. Vannevar Bush of M. I. T., Monsieur Andre of the La Radio Technique of Paris, Mr. J. A. Spencer, inventor of the Million Dollar Thermostat, and many others. The equipment at their disposal cannot be duplicated anywhere. It is little wonder that those close to radio power problems look to Raytheon for their most effective solution.

RAYTHEON MANUFACTURING COMPANY
CAMBRIDGE, MASSACHUSETTS

"Approved by Raytheon"

Manufacturers of Complete B-Power Units, Raytheon-equipped:

Acme Apparatus Co., Cambridge, Mass.
All-American Radio Corp., Chicago, Ill.
American Electric Co., Chicago, Ill.
Apco Mfg. Co., Providence, R. I.
Cornell Elec. Mfg. Co., L. I. City, N. Y.
Electrical Research Labs., Inc., Chicago
General Radio Co., Cambridge, Mass.
Grigsby-Grunow-Hinds Co., Chicago, Ill.
King Elec. Mfg. Co., Buffalo, N. Y.
Kokomo Electric Co., Kokomo, Indiana
Mayolian Radio Corp., Bronx, N. Y.
The Modern Elec. Mfg. Co., Toledo, O.
Pathe Phonograph Co., Brooklyn, N. Y.
Sparks-Withington Co., Jackson, Mich.
The Sterling Mfg. Co., Cleveland, Ohio
Storad Mfg. Co., Cleveland, Ohio
J. S. Timmons, Inc., Germantown, Phila.
Valley Electric Co., St. Louis, Mo.
The Webster Co., Chicago, Ill.
Zenith Radio Corp., Chicago, Ill.



The Romance of Raytheon

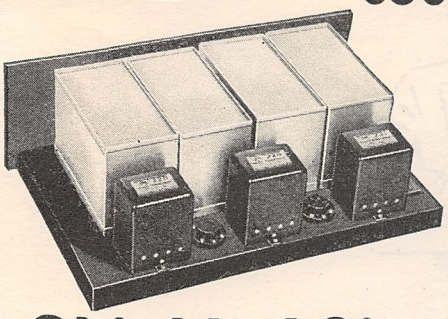
By DONALD WILHELM

BETWEEN the time Mr. Smith set to work on his research, and the time that the Raytheon Rectifier was produced there were many hours, days, and months of dreams, discouragement, thrilling discovery, and patience. It makes good reading. For example, we think of copper as being an excellent conductor, yet Mr. Smith found that he could pass seventy times as much current through a column of gas as through a copper wire of the same diameter.

If you are interested to know more about the years of research resulting in the development of the Raytheon Rectifier, we shall be glad to mail you a leaflet telling the story in the words of Mr. Donald Wilhelm, author of "The Story of Steel," "The Story of Wrought Iron," and many other publications. Drop us a line.

RAYTHEON rectifier

SM 630



Shielded Six

Endorsed and approved by Radio Broadcast, Citizens Radio Call Book and many other prominent publications and newspapers.

The Shielded Six is one of the highest types of broadcast receivers. It embodies complete shielding of all radio frequency and detector circuits. The quality of reproduction is real—true to the ear.

Behind the Shielded Six is competent engineering. It is sensitive. Day in and day out it will get distance—on the speaker. It is selective. Local stations in the most crowded areas separate completely—yet there are but two dials to tune.

These features—its all-metal chassis and panels, its ease of assembly, and many others—included in the small class of ultra fine factory built sets, priced at several times the Six's cost.

The SM-630 Shielded Six Kit—including all specified matched and measured parts to build this remarkable receiver—price $95.00.

The 633 Essential Kit—contains 4 condensers, 4 R.F. transformers, 4 coil sockets, 4 stage shields and the link motion—all laboratory matched—price $45.00.

Clear and complete instructions, prepared by S-M engineers, go with each kit—or will be mailed separately for 50c.

220 & 221
Audio Transformer

S-M 220—the big, husky audio transformer you hear in the finest sets—the only transformer with the *rising* low note characteristic that means real quality—not only on paper—but when you hear it. It is a power job—yet this finest of audio amplifying devices is sold, with a guarantee for but $6.00.

The S-M 221 is an output transformer that will bring out the low notes on your present set. It should be used between the last audio tube and the loud speaker — it eliminates blasting and will increase speaker capacity for handling strong signals without distortion, $6.00.

Prices 10% higher west of the Rockies

Silver-Marshall, Inc.

848 W. Jackson Blvd., Chicago, U. S. A.

tube is used in Fig. 3 and is a "Y-tube" with the forks of the "Y" leading into the stationary wave chamber at spots separated by a half wavelength of the static noises.

Since 180° phase difference in the "static" tone can be changed to any phase difference we like—within reasonable limits—for letting out C.W. signal tone, this signal stationary wave can act, practically undisturbed, while the static stationary wave is more or less blocked. It has actually been reduced from 2,000 to less than 94 audibility by using the counterphase tube alone.

PARTS MAKING UP "ACOUSTAT"

The signal should preferably be amplified on an untuned cascade resistance coupled amplifier for DX work. If this is not necessary on account of favorable conditions, so much the better. A negative bias of 1½ volts and suitable plate voltage may be used with cumulative grid rectification. This tends to reduce over-modulation of the local heterodyne oscillations by the static pulses and generally transmits them to the A.F. stages intact.

This initial amplifier (I.A.) can give signals from 200 to 2,000 audibility with static of 2,000 to 20,000 audibility—the latter being an estimate.

This initial amplifier (I.A.) can give sig- for the I.A. comes next. It converts the A.F. currents to signals and the static to air impulses in the input end of the "Acoustat". Hence it must be highly damped and yet with a definite natural period of its own—preferably different from that of the echo chamber—usually a little higher. For example if the echo chamber is tuned to 1,000 cycles and 666 cycles—the sound producer should have a free period corresponding to about 700 cycles.

It is helpful to use a percussion chamber, consisting of a closed space, as "V" in Fig. 4 or a semi-open space, shown at "A" in Fig. 3, acoustically driven by the sound producer, but which is not tuned. Its principal function is to secure in the echo chamber—following it—the best approximation to a pure sine wave possible, as produced by a static "snap," "click," or pulse.

The "echo-chamber," sometimes called the "reverberator," is meant to pass on the beat tone signal and transmit the "static" tone produced in it, into the final or wave cham-

AMAZING STORIES

IN OUR NEXT ISSUE:

THROUGH THE CRATER'S RIM, by A. Hyatt Verrill. A brave explorer sets out to find an entrance into "The Lost City" and the story tells of his exciting and dangerous adventures.

THE FIRST MEN IN THE MOON, by H. G. Wells. This is undoubtedly one of the greatest moon stories ever written. Somehow or other you gain the impression that it is all very true. Don't fail to read this extraordinary and amazing story.

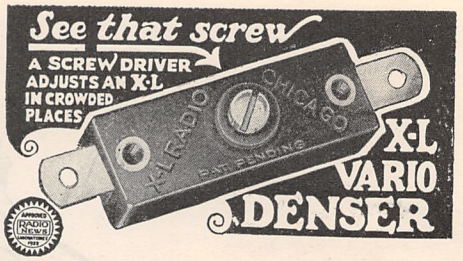
THE TIME ELIMINATOR, by Kaw. This is a scientific love story. By utilizing light waves produced in the remote past, the events of preceding centuries and years are thrown upon a screen and a bride is won thereby; but how?

THE SECOND DELUGE, by Professor Garrett P. Serviss. The second installment of this engrossing story. Read about the Noah of the future, who builds his ark out of a marvelous light metal of the coming ages.

THE DIAMOND LENS, by Fitz-James O'Brien. This is one of the world's classics in the realm of scientific fiction. It is based on a lovely apparition, an exquisite microscopic being, the enchanting heroine of the story.

PRICE 25c PER COPY
AT ALL NEWSSTANDS

See that screw
A SCREW DRIVER ADJUSTS AN X-L IN CROWDED PLACES



X-L VARIO DENSER

RESULTS in easier tuning, more distance, volume and clarity—greater stability. Indorsed by leading authorities.

MODEL "N"—A slight turn obtains correct tube oscillation on all tuned radio frequency circuits. Neutrodyne, Robert's two tube, Browning-Drake, McMurdo Silver's Knockout, etc. Capacity range 1.8 to 20 micro-micro farads. PRICE $1.00

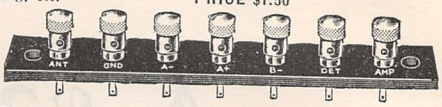
MODEL "G"—with grid clips obtains the proper grid capacity on Cockaday circuits, filter and intermediate frequency tuning in heterodyne and positive grid bias in all sets.

CAPACITY RANGE

Model G-1—.00002 to .0001 MFD
Model G-5—.0001 to .0005 MFD
Model G-10—.0003 to .001 MFD
PRICE $1.50

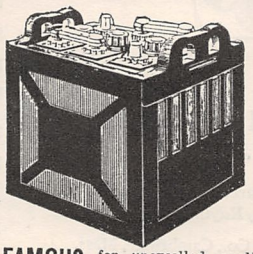
X-L PUSH POST—Push it down with your thumb, insert wire, remove pressure and wire is firmly held, releases instantly. PRICE 15c

PUSH POST PANEL — permanently marked in white on black insulating panel. In box including soldering lugs, raising bushings and screws for mounting, etc. PRICE $1.50



X-L Radio Laboratories, 2426 LINCOLN AVE., CHICAGO, ILL.

The INFRADYNE SUM FREQUENCY AMPLIFIER uses Five X-L Push Posts



CHICAGO
RADIO
BATTERIES
AUTO

Solid One Piece Rubber Containers
GUARANTEED FOR 2 YEARS

FAMOUS for unexcelled quality, guaranteed long-lived service and unvarying dependability. Chicago Batteries offer the Radio fan an "A" Power that is backed by years of experience and master workmanship with the finest materials available. Endorsed and approved by leading Radio and Automotive authorities. Chicago Batteries in their new non-leak, solid rubber cases represent an amazing value at lowest cost.

PRICES
SOLID RUBBER CASE
RADIO BATTERIES

6 volts, 100 amps. ..... $ 8.29
6 volts, 120 amps. 10.29
6 volts, 140 amps. 12.45

SAVE MONEY—ORDER DIRECT

Buy Chicago Batteries direct from the manufacturer. Batteries shipped same day order is received. Express C O D or 3% discount cash with order.

MOGUL ELEC. LABS.
1210 So. Peoria St. Chicago, Ill.

RADIO CATALOG

Dealers! Send for our new 1927 Catalog. Contains nationally advertised high quality sets, kits and parts.

Use your letterhead.

Western Radio MFG CO.
134-136 W. Lake St. Chicago, Ill.

Learn Watchwork, Jewelrywork and Engraving A fine trade commanding a good salary, and your services always in demand. Address Horological, Dept. 5, Bradley Institute, PEORIA, ILLINOIS, for our latest catalog.

Sign off to sweet dreams

You enjoy radio like a gentleman—if you can get the best out of your set and forget all worry and bother. That's your happy frame of mind when you keep your batteries full of pep with a Rectigon. The most absent-minded dial twister snaps on a Rectigon without a qualm. What if you do tune in while you're still charging your battery? There's no harm done, not the slightest. What if the current does go wrong in the dead of night? Your batteries will not be discharged with a Rectigon attached.

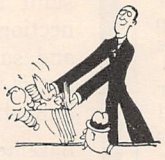
when you keep power in your set with

The Westinghouse Rectigon Battery Charger

©, 1926, W. E. & M. Co.

No noise as it charges—not a bit of fuss. Not even a murmur that would disturb the mildest slumber.

No acids, no chemicals—no moving parts—nothing to spill or burn. No muss, no worry. You'll have no spoiled rugs, no ruined clothing.



Saves its cost in short order—Count the dollars spent in a few trips to the service station and you'll hotfoot it for a Rectigon, for the good it does your pocketbook as well as your batteries.

Snaps on in an instant—Just plug into the light socket, snap on the terminals. Saves service station bother. Spares interruptions caused by absent batteries.

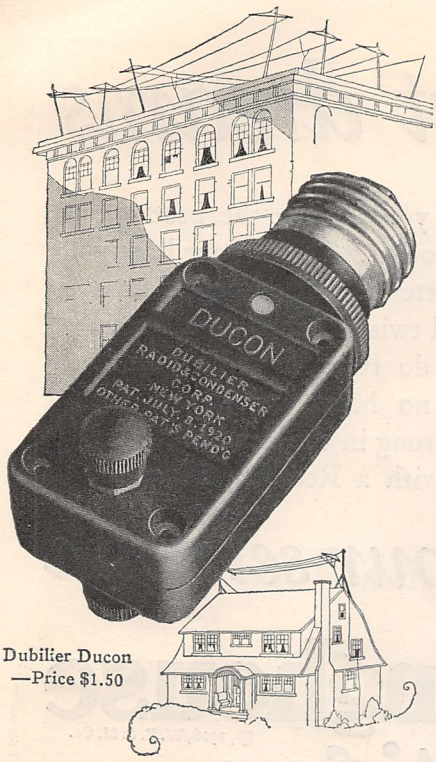
Charges both "A" and "B" batteries—Keeps both packed with power. Bulb is used for "B" battery charging and it is enclosed, like all other parts, in metal, safe from accident. (Rectigon charges automobile batteries, too.)

THE RECTIGON is a superb Westinghouse product. Things you *can't* see, like extra heavy insulation, things you *can* see, like the durably enameled case—all are of highest quality. Westinghouse also manufactures a complete line of radio instruments, and Micarta panels and tubes.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

Tune in on KDKA - KYW - WBZ - KFKX

No Storage Battery Radio is Complete Without a Rectigon



Dubilier Ducon
—Price $1.50

The Shortest Aerial in the World

In the old days, when radio was new, the "fan" was known by crazy festoons of wire that decorated his housetop or yard. These were the old fashioned aerials, and no one has forgotten all the grief they caused.

Modern radio may use the hidden loop, or the short indoor aerial. But there is a better way. The Dubilier Ducon enables you to use the complete wiring system of your house without risk, and with better results than most outdoor aerials give.

You simply screw a Dubilier Ducon into any lamp socket, and connect it with the antenna binding post of your set. You will find that it increases selectivity—especially in crowded neighborhoods, and will reduce "static" in the summertime.

Try a Dubilier Ducon on your set tonight. They are sold by all good dealers on five days' trial for $1.50.

Dubilier
CONDENSER AND RADIO CORPORATION
4377 Bronx Blvd., New York, N. Y.

ber, shown in Fig. 4. Then we have a 3-stage A.F. reamplifier.

Sometimes another chamber is added for combined reflection and stationary wave effects, but this is not necessary unless QRM is very heavy as well as QRN.

TUNING THE ACOUSTAT

The tuning of the echo chamber and wave chamber is done by listening through a flexible tube at a small opening in the further end of each as the beat tone is varied. Then by changing their lengths, as they have sliding walls—the predetermined pitch is tuned for. The best adjustment of the percussion chamber for distance from the loudspeaker or other A.F. converter is a matter of cut and try. A "thump" or "click" by means of finger contact on the I.A. grid, is listened for, at the end of the "echo-chamber" and this is then finally adjusted for the predetermined static tone, by the following procedure.

The diaphragm is moved to or from the percussion chamber a slight amount while "clicking" it. This is repeated at several points and the point where the change in intensity is sharpest from the maximum sound of the "click" is selected. This does not, however, mean that the percussion chamber is truly resonant but it does mean that the energy distribution on the static tone is approximately the best.

SHORT-WAVE WORK

Short-wave work with the Acoustat will depend on the steadiness of the wave and—in the form shown in Fig. 3, with an echo-chamber and just an added wave chamber with counterphase tube—the wave chamber can sometimes be constantly moved to keep pace with the change in signal tone if this occurs, not too rapidly.

As regards the question of 15-150 meter work with the Acoustat. There is an added element which must be taken care of before the apparatus can function as well as it does on waves of greater length. This is fluctuation of frequency from amateur short-wave transmitters.

If the arrangement with the "reflection-absorption" chamber is used the A.F. tuning is .6% to 2% and these short-wave signals will be lost. If this chamber is omitted, and the pick-ups have the widest spacing—¼ inch—between discs—the signal beat can change by 20% before it becomes seriously weaker.

By using 4,000 cycles, as a beat-note, this gives a margin of frequency-tolerance of .8 kc. without serious impairment of signal. At 2,000 kc. this would be a frequency tolerance of .04%, which can scarcely be held without piezo-crystal oscillators, as frequency regulators.

A beat tone of 100,000 cycles being supersonic, must be used to actuate a relay. This would make the above frequency tolerance 25 times as great, or 1%. This is easily held by short-wave transmitters and .5% is also a safe margin.

A beat frequency of 50 kc. means that 10 kc. variation of the C.W. signal wave gives a 20% variation in the beat frequency. This does not seriously impair the message when the counterphase tube is used as shown in 14-15 in Fig. 3.

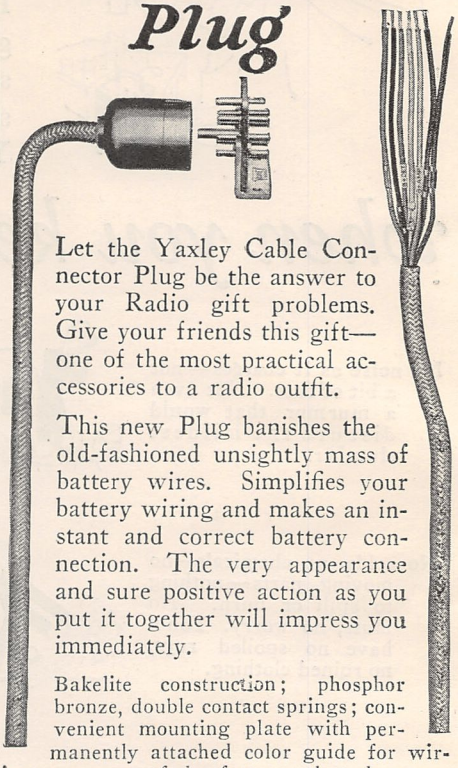
INDEPENDENCE FROM FREQUENCY SWINGING

In some tests on the Acoustat, with "ticker"—wheels and modulating grid-buzzers—the problem of "swinging" or change of "beat" note in the heterodyne was gotten rid of. It is obvious that buzzer modulation, with a good type giving a 2-to-1 A.F. range can be used in place of the heterodyne in the initial amplifier.

There is considerable weakening of the signal, but the "skip effect" may be expected, in 10-100 meter waves to compensate for this to some degree. Every worker

YAXLEY
APPROVED RADIO PRODUCTS

Cable Connector Plug



Let the Yaxley Cable Connector Plug be the answer to your Radio gift problems. Give your friends this gift—one of the most practical accessories to a radio outfit.

This new Plug banishes the old-fashioned unsightly mass of battery wires. Simplifies your battery wiring and makes an instant and correct battery connection. The very appearance and sure positive action as you put it together will impress you immediately.

Bakelite construction; phosphor bronze, double contact springs; convenient mounting plate with permanently attached color guide for wiring, are some of the features that show you the unusual merits of the Yaxley Cable Connector Plug.

No. 660 as illustrated **$3.50**

No. 670 for the set with binding posts—no soldering. Just hook up the terminals to your set and batteries and the job is done.. **$4.00**

At your dealer's If he cannot supply you send his name with your order to

YAXLEY MFG. CO.
Dept. N.
9 So. Clinton St. Chicago, Ill.

The American Trickle Charger $6.00
RELIABLE NO EXPERIMENT
WRITE TO US DIRECT
AMERICAN BATTERY CO.,
2057 N. Racine Ave., Est'd 1889 CHICAGO

SAVE ⅓ TO ½!
Everything in Radio
WRITE for CATALOG—FREE
RANDOLPH RADIO CORP.
180 N. UNION AV. Dept. 2 CHICAGO, ILL.

Insure your copy reaching you each month. Subscribe to RADIO NEWS — $2.50 a year. Experimenter Publishing Co., 53 Park Pl., N. Y. C.

MAGNAVOX CONE SPEAKER

(PATENTED)

Another MAGNAVOX marvel ♪ Now a radio loud speaker reproduces the entire tonal scale ♭ all notes, all instruments, all enunciations, precisely as rendered. You can now hear 📻 radio programs as you've never heard them before. It is a history making achievement, quite as marvelous as the original radio loud speaker which was also a MAGNAVOX. ♩ Go hear a demonstration. Let your ears ♫ prove the vast difference. The *Cornell* model, pictured here, $22.50. *Stanford* model—all mahogany case, $35.00. They operate with and improve any radio set. MAGNAVOX is the world's popular loud speaker—400,000 now in use.

THE MAGNAVOX COMPANY • *Oakland, California*
R. S. Williams & Sons Co., Ltd., Toronto, Distrs. for Canada [not including B. C.]

59N © 1926

FIFTEENTH ANNIVERSARY OF MAGNAVOX PROGRESS IN RADIO

R.F.I.
BALANCED
OVAL CONE SPEAKER

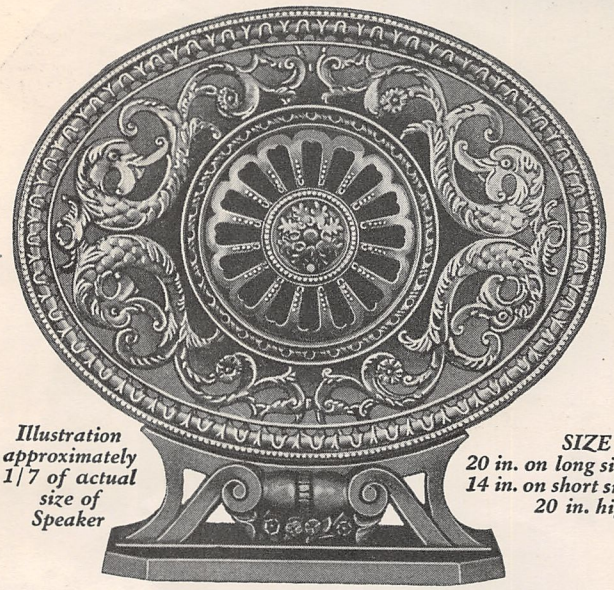


Illustration approximately 1/7 of actual size of Speaker

SIZE
20 in. on long side of oval
14 in. on short side of oval
20 in. high

AT LAST all the high notes and all the low notes! A small cone gives high notes only. In a large cone, low notes predominate. In the R. F. I. *Balanced* Oval Cone Speaker the long side of the oval stresses the low notes and the short side stresses the high notes, and the two give a *complete balance*. Wonderful volume, clear tone, and all mechanical parts hidden. The insistent demand for more beauty in radio loud speakers is met by the R. F. I. Oval. It is a pure renaissance reproduction, designed by A. Kimball & Son, New York. Free of all patent infringements, licensed under all the Lektophone patents. Old Gold or Statuary Bronze.

Price $25.00—West of Rockies $26.50
Supplied on Approval by Your Dealer

Mr. JOBBER or Mr. DEALER
Write or Wire for Agency

RADIO FOUNDATION INCORPORATED
25 WEST BROADWAY - - - - NEW YORK

Dealers! Set Builders!
Write for
FREE
RADIO CATALOG

1. Right Prices
2. Quick Delivery
3. Advertised Lines
4. Complete Stock
5. Dealer Cooperation

Be Sure to Use Business Letterhead When Answering

CHICAGO RADIO APPARATUS CO.,
415 S. Dearborn St., Dept. RN., Chicago

"CHI-RAD"

Bradleyleak
THE PERFECT GRID LEAK

Provides a noiseless range of grid leak resistance from ¼ to 10 megohms. Assures most effective grid leak resistance value for *all* tubes. Small grid condenser (0.00025) is separate. Metal parts nickel plated. One hole mounting.

Allen-Bradley Co.
Electric Controlling Apparatus
287 Greenfield Avenue Milwaukee, Wis.

who can thus modulate the C.W. signals, by a rotating vernier condenser shunting the tuning condenser, can use the Acoustat for any C.W. length whatever.

The signal note must not vary more than 2% if the "absorption-reflection" chamber is used. If this chamber is omitted, a 5 to 10% pitch variation may be used, depending on the amount of QRM present.

Progress In Radio

(Continued from page 672)

applications, both for radio and other electrical purposes. Once the galvanometer is set at zero with the tube oscillating, the slightest variation in the capacity of the tuning condenser C1, or in inductance L, will displace the galvanometer needle several divisions. Again, if a variable grid leak be employed instead of the fixed grid leak R1, the slightest variation in its value will be recorded by galvanometer movements.

—Wireless World.

RADIO SIGNAL TRANSMISSIONS OF STANDARD FREQUENCY, NOVEMBER TO APRIL

The Bureau of Standards announces a new schedule of radio signals of standard frequencies, for use by the public in standardizing frequency meters (wave meters) and transmitting and receiving apparatus. The signals are transmitted from the Bureau's station, WWV, Washington, D. C.

The transmissions are by continuous-wave radio telegraphy. The signals have a slight modulation of high pitch which aids in their identification. A complete frequency transmission includes a "general call," a "standard frequency signal," and "announcements." The "general call" is given at the beginning of the 8-minute period and continues for about 2 minutes. This includes a statement of the frequency. The "standard frequency signal" is a series of very long dashes with the call letter (WWV) intervening. This signal continues for about 4 minutes. The "announcements" are on the same frequency as the "standard frequency signal" just transmitted and contain a statement of the frequency. An announcement of the next frequency to be transmitted is then given. There is then a 4-minute interval while the transmitting set is adjusted for the next frequency.

The signals can be heard and utilized by stations equipped for continuous-wave reception at distances up to about 500 to 1,000 miles from the transmitting station. Information on how to receive and utilize the signals is given in Bureau of Standards Letter Circular No. 171, which may be obtained on application from the Bureau of Standards, Washington, D. C. Even though only a few frequency points are received, persons can obtain as complete a frequency meter calibration as desired by the method of generator harmonics, information on which is given in the Letter Circular. The schedule of standard frequency signals is as follows:

SCHEDULE OF FREQUENCIES IN KILOCYCLES
(Approximate wavelengths in meters in parentheses)

Eastern Std. Time	Nov. 20	Dec. 20	1927 Jan. 20	Feb. 21	Mar. 21	Apr. 20
10:00 to	1500	3000	125	300	3000	550
10:08 p.m.	(200)	(100)	(2400)	(1000)	(100)	(545)
10:12 to	1050	3300	133	315	3300	630
10:20 p.m.	(182)	(91)	(2254)	(952)	(91)	(476)
10:24 to	1800	3600	143	345	3600	730
10:32 p.m.	(167)	(83)	(2097)	(869)	(83)	(411)
10:36 to	2000	4000	155	375	4000	850
10:44 p.m.	(150)	(75)	(1934)	(800)	(75)	(353)
10:48 to	2200	4400	166.5	425	4400	980
10:56 p.m.	(136)	(68)	(1800)	(705)	(68)	(306)
11:00 to	2450	4900	205	500	4900	1130
11:08 p.m.	(122)	(61)	(1463)	(600)	(61)	(265)
11:12 to	2700	5400	260	600	5400	1300
11:20 p.m.	(111)	(56)	(1153)	(500)	(56)	(231)
11:24 to	3000	6000	315	666	6000	1500
11:32 p.m.	(100)	(50)	(952)	(450)	(50)	(200)

25c *at Daven Dealers*
30c *by Mail*

Even if you can't drive a nail in straight—you can build the

Finest Set You Ever Heard!

THE set that radio fandom is talking about—and building, in tremendous quantities, can now be built by anyone.

No matter if you have never built even a one-tube set before—no matter if you have never had a screw-driver in your hands before—you, with the book, "How to Make a Daven Bass Note Circuit", can equal the jobs of an expert.

Every conceivable question is answered. Every part is shown life size in the drawings. Every connection is numbered—and with the "A B C" wiring chart no one could possibly make a mistake.

The Daven Bass Note Set in its new two dial layout is even better than ever before—the new Daven Balancer and Compensator make tuning even sharper and easier than ever before.

Get the book today — it will be one of the best radio investments you ever made. The Daven Bass Note Set will open your eyes—and your ears! Your Bass Note Set will be the talk of your neighborhood—everyone will want to copy it. Secure your copy now, as the first edition is going rapidly, and you might have to wait for another printing.

This Resistor Doesn't Charge.

The Daven Glastor, the new Transparent Resistor, is noiseless and enduring. Comes in complete range of resistances.

DAVEN
BASS NOTE CIRCUIT
For Complete Radio Reception

New Resistor for "B" Eliminators

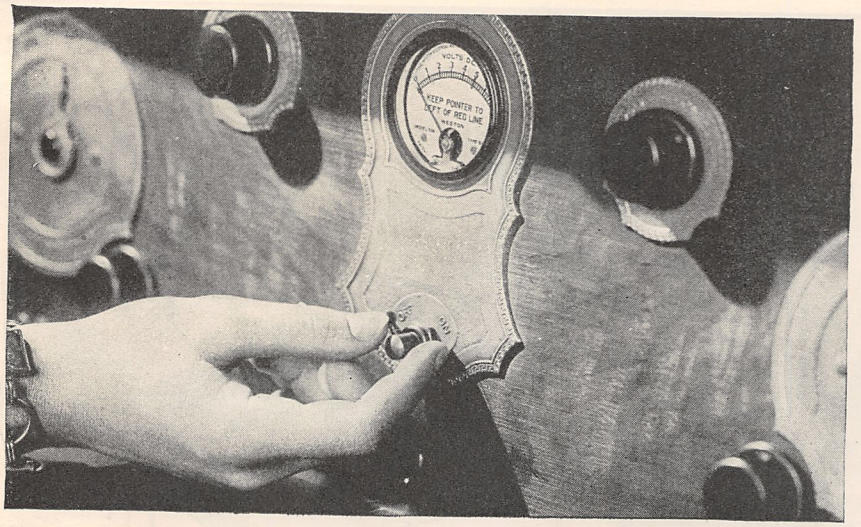
The Daven Hi-Duty Glastor is specially designed to carry the highest currents known to radio without change or loss.

NEW 8th EDITION DAVEN MANUAL

This valuable book, explaining Daven Amplification, has been just newly revised. It will tell you in full detail how to apply Daven Amplification to YOUR set. 25c at dealers—30c by mail.

FREE CATALOG ON REQUEST

The Sine of Merit
DAVEN RADIO CORPORATION
Trade Mark *Resistor Specialists* Registered
142 Summit Street Newark, N. J.



At a click of your set switch

—AUTOMATIC *radio operation*
—NEVER-FAILING *power*
—UNDISTURBED *reception*

AT one click of the set switch — Unipower supplies even, unfailing "A" power, and controls "B" power *automatically!* No matter what set or "B" power you use—Unipower enables complete radio operation under one control.

Unipower does far more, in fact. It furnishes the exact amount of "A" power required by your particular set,—at any time—under any condition. Your reception is saved from the crashing and grating of over-charge—and the sickly fading of insufficient power.

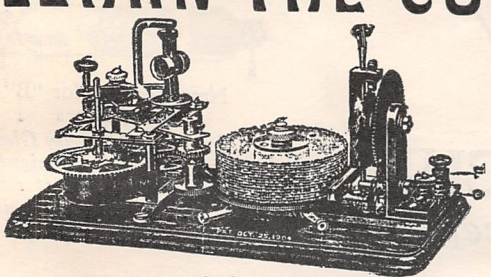
Never, as before, need you be without the use of your set for days, even hours at a time. Unipower's full current assures permanent, continuous reception — always of clearest tone and finest quality.

Time-tested, proven again and again, Unipower cannot fail. It is built by the same skilled experts who, for 30 years, have made Gould quality renowned everywhere. And its trouble-proof construction and everlasting performance have earned it the highest praise of radio engineers and manufacturers. Ask your dealer how easily and cheaply Unipower can be yours. [Unipower contains a Balkite charging unit of Gould design]. The Gould Storage Battery Co., Inc., 250 Park Avenue, New York.

Unipower
A GOULD PRODUCT

AUTOMATIC "A" POWER THAT CANNOT FAIL

LEARN THE CODE AT HOME



WITH THE OMNIGRAPH

THE OMNIGRAPH Automatic Transmitter will teach you both the Wireless and Morse Codes—**right in your own home**—quickly, easily and inexpensively. Connected with Buzzer, Buzzer and Phone or to Sounder, it will send you unlimited messages at any speed, from 5 to 50 words a minute.

THE OMNIGRAPH is not an experiment. For more than 15 years, it has been sold all over the world with a money back guarantee. The OMNIGRAPH is used by several Depts. of the U.S. Govt.—in fact, the Dept. of Commerce uses the OMNIGRAPH to test all applicants applying for a Radio license. The OMNIGRAPH has been successfully adopted by the leading Universities, Colleges and Radio Schools.

Send for FREE Catalog. DO IT TODAY.

THE OMNIGRAPH MFG. CO., 15 HUDSON STREET, NEW YORK CITY

If you own a Radio Phone set and don't know the code—you are missing most of the fun

Insure your copy reaching you each month. Subscribe to Radio News—$2.50 a year. Experimenter Publishing Co., 53 Park Place, N. Y. C.

Design Engineering In Radio Apparatus

(*Continued from page 669*)

as a model achievement on which to base future designs is the height of folly. No man knows where the thing starts and no man is satisfied with the end. Label this article prayer or plea, if you will; but accept, if you please, the need for a fundamental principle upon which to build our radio receivers, no matter of what hook-up they are.

As can be seen, I offer, as humbly as may be, such a foundation when I say, build your receivers in straight-line sequence; *in at the first grid, out at the last plate.* Construct all battery leads so that they are automatic by-passing condensers, incapable of creating any external field, offering a known fixed impedance in the battery circuits, and unable to pick up any outside field, such as static, signals or radio-frequency. Accept a definite form of structural design as correct and you will spend less time harnessing radio frequency and more time in working it.

Constructional or "How to Build" articles in this series will describe receivers built upon our foundation of straight-line sequence, automatic battery by-passing, with as little wire as possible.

As a result of this method they will have, automatically, correct spacing and location of all parts. After all the components are at hand it should be possible, with the design to be shown, for the average builder to assemble the seven-tube superheterodyne, for instance, in less than an hour, and to have the assurance that the receiver is a duplicate of the original design.

"Wired Radio" In England

WALLACE MATON, a radio dealer at Hythe, a small town near Southampton, England, is the central figure in a controversy with the general post office authorities.

This enterprising gentleman possesses a five-tube receiving set; and, with the aid of privately installed telephone wires relays the B. B. C. programs to twenty of his clients, some living more than half a mile away. To the terminals at the subscribers' end a loud-speaker is attached, enabling them

40 Non-Technical Radio Articles

every month for the beginner, the layman and those who like radio from the non-technical side.

SCIENCE & INVENTION, which can be bought at any newsstand, contains the largest and most interesting section of radio articles of any non-radio magazine in existence.

Plenty of "How To Make It" radio articles and plenty of simplified hook-ups for the layman and experimenter. The radio section of SCIENCE & INVENTION is so good that many RADIO NEWS readers buy it solely for this feature.

Radio Articles Appearing in the December Issue of "Science and Invention" Magazine.

WRNY's New Remote-Control Transmitter.
How to Make a Simple Drum Dial, By Herbert E. Hayden.
The Famous Lodge "N" Circuit, By James Francis Clemenger.
How to Build a Good "B" Eliminator.
Radio Wrinkles—Illustrated.
Radio Oracle—Questions and Answers.

Bridge the Gap

between your set and 1927 standards of radio reception

Link the Remler Infradyne Amplifier with your neutrodyne or tuned radio frequency circuit and get reception such as you have never known.

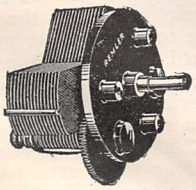
This Amplifier gives:

1. Loud speaker volume to signals ordinarily inaudible.
2. Clear sharp reception through all the interference of conflicting stations.
3. Better separation of stations on the dial than you have ever had before.

The Amplifier and its component parts can be easily and simply added without breaking into the wiring.

price $25.00

Write for two color descriptive circular and for reprints from RADIO.



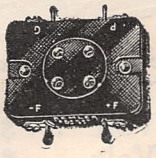
Remler Twin-Rotor Condenser Price Less Dial $4.50

REMLER

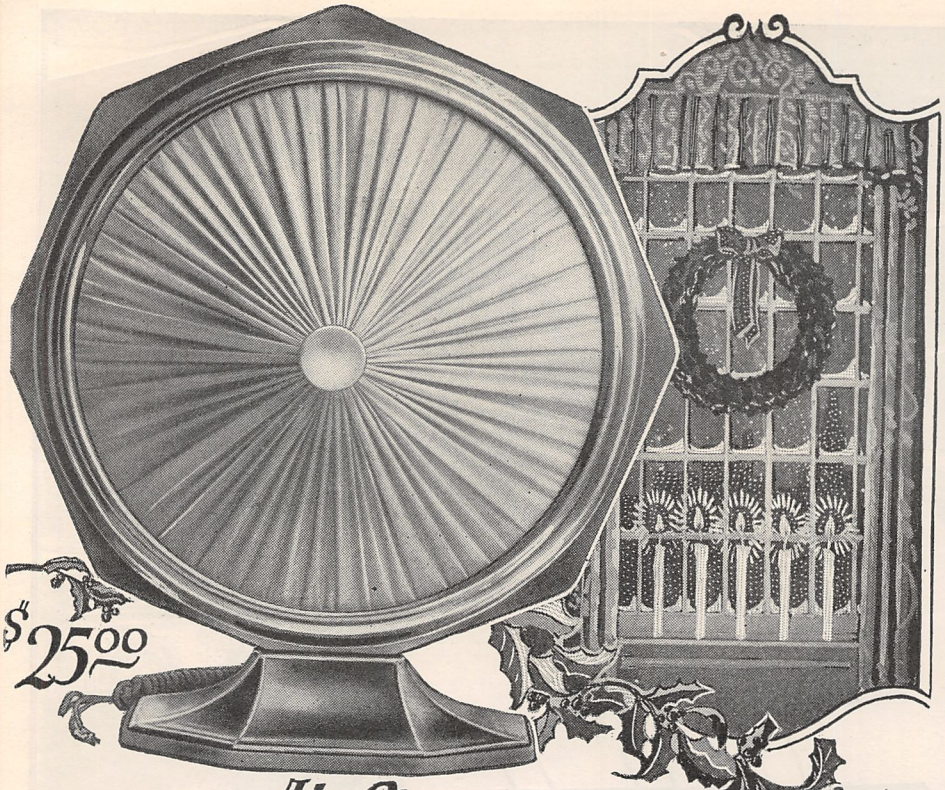
GRAY and DANIELSON Manufacturing Company

DIVISION OF R

Remler Improved Socket No. 50 Price 50c



CHICAGO 260 FIRST STREET - SAN FRANCISCO NEW YORK



At Christmastide

The

SONOCHORDE CONE

BY those who have tried them all Sonochorde is recognized as the premiere achievement in radio acoustics. Instead of paper, Sonochorde presents a rich wine-colored front of silk with unbreakable metal frame and base, finished in mahogany —a musical instrument of beauty. Three models to choose from —Wall, Floor Standard and Table, each equipped with the original super-powered Sonochorde unit. Compare Sonochorde with any Speaker regardless of price. Then buy as your eyes and ears direct. On sale by leading dealers.

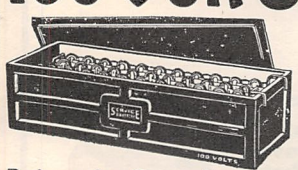
Send for the Sonochorde Story.

BOUDETTE MFG. CO. CHELSEA, MASS.

Factory Sales Agents

Hastings Electric Sales Co., 42 Binford St., S. Boston

100 Volt Storage "B" Battery $10



Everybody can now enjoy the benefits of Storage "B" Batteries—more power, quieter reception, greater economy. Rubber case prevents leakage or shorting. Easy to recharge. Will last for years with ordinary care.

SERVICE Rechargeable "B" Batteries

in all-rubber cases

100 VOLTS $10.00

50 VOLT $5.50

125 VOLT $12.50

Prices in Canada:

50 Volt . . $7.75

100 Volt . . $14.50

125 Volt . . $17.00

SERVICE "A" Batteries

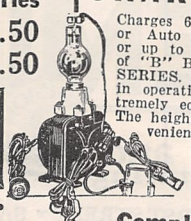
Indestructible rubber case. 2 year guarantee.

6 Volt. 100 amp. hr. $14.00

6 Volt. 120 amp. hr. $16.00

SERVICE Double-Duty CHARGER

Charges 6-volt "A" or Auto Batteries or up to 125 volts of "B" Battery IN SERIES. Noiseless in operation. Extremely economical. The height of convenience.



Complete with Bulb $14.50

SERVICE BATTERY CO. *of Canada,* 137 Roncesvalles Ave. Toronto, Ontario

SERVICE BATTERY CO.

704 East 102nd Street Cleveland, Ohio

to listen in without having a radio receiver, in the true meaning of the word, at all; although they individually enjoy the benefits of a bona-fide license holder. The charge for this privilege is one shilling and six pence (36 cents) per week, the subscribers buying the loud-speakers themselves.

The post office officials say that Mr. Maton is transgressing the first condition of his radio license, which stipulates that the station must not be used for any purpose other than receiving messages in the premises occupied by the holder. The matter does not end here, apparently. The subscribers to this private exchange are liable themselves to proceedings for using radio apparatus without a license.

After the radio officials have had their say the telegraph acts will then be considered; these make it illegal to institute a system of public telephonic communication in any exchange area without the license of the postmaster general.

So it seems that Mr. Maton will be in hot water all round, for an idea that was at once ingenious and original.

This case attracted the notice of the post office on August 6 and it is taking immediate steps to get a high court ruling on the matter. Doubtless, when the full glare of public attention has been focused on the case, the radio laws of England will have to undergo a searching test; and definite laws made to cope with this and other problems relating to radio.

NO "SEARCH AND SEIZURE" LAW

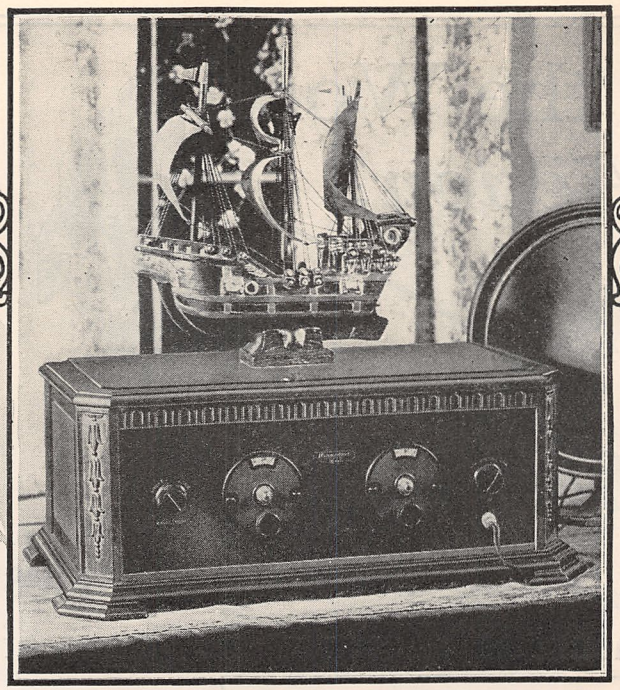
Only a short time ago a London householder had refused admission to the post office authorities, who wished to search his house for radio apparatus, because he had an aerial erected but was without a license. Acting on the assumption that "an Englishman's house is his castle," he defied them from an upper bedroom window. With all doors locked and a large Union Jack hanging over the front door, this gentleman held out until it was realized that without a warrant the door could not be smashed in. No magistrate could grant a warrant; for the law as it stands has made no provision for this exigency. Mr. Maton is less fortunate, as he has transgressed existing laws.

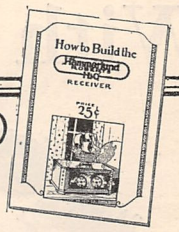
—Reported by *A. L. Wells*

The "wired radio" system of Mr. Maton has since been authorized by the post office authorities, on condition that all his subscribers have receiving licenses.—Editor

TROUBLES OF FOREIGN RADIO FANS

THREE-FIFTHS of the broadcasting stations of the world are in the United States, which has five times more receiving sets than the next country, Great Britain. This is not due, however, entirely to superior enterprise of Americans or greater Yankee ingenuity. This is the only large country where anyone is free to transmit, or even to listen. In Greece only a Greek can own a receiver; in other European countries there are national discriminations, and regulations are everywhere numerous. Great Britain charges $2.44 a license—Peru, $4.00. In Japan the government license costs 1 yen (50 cents) a year and a subscription fee to the local broadcaster from one to two yen per month. Transmitters are taxed. In Bulgaria, no private individuals may transmit anything but news or talks on agriculture. In Greece it is unlawful to own a receiver which can be tuned to more than 2,000 meters wavelength and possessors of long-wave sets had to turn them in for adjustment. In Hungary there is a fine for unauthorized listening-in of three millions of kronen, which, however, is but $43. In parts of China the importation of radio is forbidden, as contraband of war.





"How To Build It" Book

Complete instructions for assembling, wiring and operating the Hammarlund-Roberts Hi-Q Receiver. Prepared under the direction of the Engineer-designers.

25c

$63.05

Complete Parts (less cabinet)

Automatic Variable Coupling, same control operates tuning condenser and primary coil coupling simultaneously, gives maximum and equal amplification and selectivity over entire tuning range.

Stage Shielding—prevents coupling between stages, eliminating oscillation and increasing selectivity. Clarifies reception.

Hi-Q Foundation Unit

Includes drilled and engraved Micarta Panel, drilled Micarta sub-panel, two complete shields, extension shaft, two equallizers, fixed resistance, hardware, wire, nuts and screws.

$10.50

Associate Manufacturers

Carter Radio Co.
Martin-Copeland Co.
Radiall Company
Samson Electric Co.
Sangamo Electric Co.
Benjamin Electric Mfg. Co.
Eby Manufacturing Co.
Hammarlund Mfg. Co.
Durham Resistors
Westinghouse Micarta

Hammarlund-Roberts Performance Means A New Measure For All Radio

THE Hammarlund-Roberts Hi-Q is an outstanding example of scientific radio engineering. No ordinary standards of tone, selectivity or volume, can be applied to this new receiver.

In designing this Hi-Q Receiver, the Hammarlund-Roberts Board of Engineers representing twelve nationally known manufacturers, had at their disposal the finest experimental laboratories—and no handicap in building to establish specifications or to a set price.

This concentration of the leaders in the perfection of one radio Receiver has developed entirely new features that produce results unknown to the average radio man. Automatic variable coupling gives maximum and equal amplification and selectivity over the entire tuning range. Stage shielding eliminates coupling between stages, prevents oscillation and increases selectivity. Two dial control simplifies tuning.

ANYONE CAN BUILD THE HAMMARLUND-ROBERTS Hi-Q

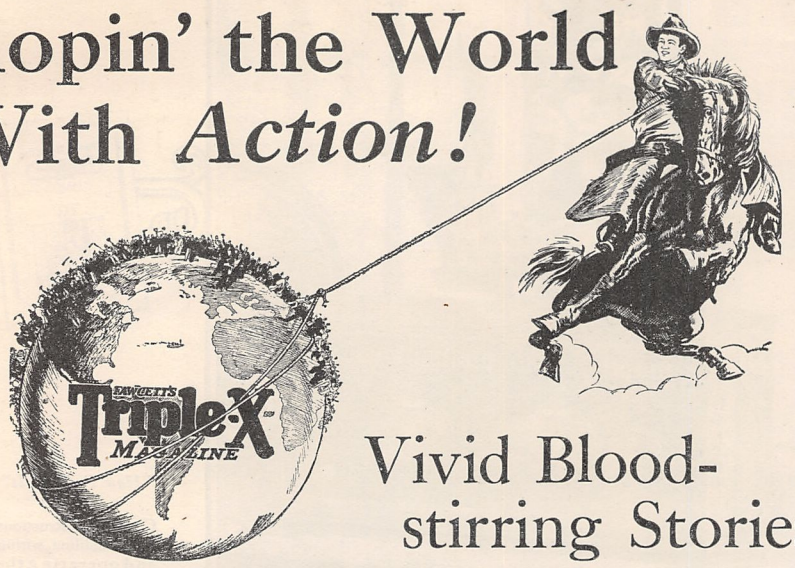
All the research, the selection of parts, the exact placing of units, has been worked out in advance for you. And you have a receiver that will equal an eight tube set—simplicity of design and operation hitherto unthought of—all at less than half the price you would pay for a factory made set of anywhere near equal efficiency.

Hammarlund ROBERTS Hi-Q*

* High ratio of reactance to resistance. High ratio—Great selectivity—Loud signals.

Hammarlund-Roberts · 1182-C Broadway : New York

Ropin' the World With *Action!*



Vivid Blood-stirring Stories

of the adventurous West fill the pages of

OUT THE 10TH OF EACH MONTH

Fawcett's Triple-X Western-Adventure Magazine MAGAZINE

PRICE ON ALL NEWSSTANDS 25c

December Issue Now On Sale

Begin H. Bedford Jones'

SIX-GUNS AND BIG 'UNS

The stirring adventures of two punchers in Paris.

THE FALL of PANAMINT PETE

By Harry A. Burton

When Jim Ott went after a bandit he proved that courage wasn't a mere matter of size.

14 Other Whirlwind Action Stories

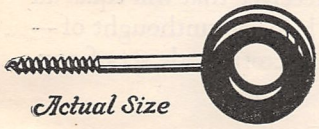
FAWCETT PUBLICATIONS, INC., Robbinsdale, Minn. (D.R.N.)

Enclosed find $1.00 (bill or check) for 6 mo. subscription to Triple-X Magazine; or, enclosed find 25c for one copy of the December issue.

Name.....Address.....

City.....State.....

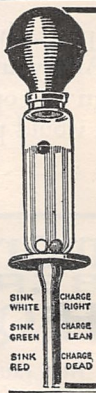
Rubber Covered Insulators



Actual Size

Neat and efficient. For antenna, ground and for lead in wires. Small screw starts readily and makes finished job. Great improvement over ordinary large, unsightly insulators. They keep the wires in place and out of the way. Packed 10 in a box, 25c at your dealers or direct from us.

CULVER-STEARNS MFG. CO.
Worcester, Mass., U. S. A.



TEST YOUR BATTERY WITH AN

SOS HYDROMETER

Without withdrawing the Hydrometer. Balls make reading simple and easy.
Swim all three, charged fully
Sinks the *white*, charge still *right*
Sinks the *green*, charge is *lean*
Sinks the *red*, charge is *dead*.

Accurate—durable—no float to read or break. Over five million patented Chaslyn Balls used by leading Battery Manufacturers as standard equipment in Glass-Cased Batteries and Power Units.
Ask your dealer. If he can't supply send seventy-five cents to

THE CHASLYN COMPANY
4617 Ravenswood Ave., Chicago

IVORY RADIO PANEL—Beautiful grained white IVORY panel with dials and knobs (inlaid with gold numerals) to match, positively cannot be equaled in beauty. And is absolutely guaranteed satisfactory or money refunded. We will cut it any size you desire only 3c sq.in., is 3/16 in. thick. Sent anywhere C.O.D. Write today for **FREE** sample. **Ivorylite Radio Panel Co., 3121 Avenue G, Ft. Worth, Texas.**

Print Your Own
Cards, Stationery, Circulars, Paper, etc. Save money. Print for others, big profit. Complete outfits $8.85. Job press $11, $29. Rotary $149. All easy, rules sent. Write for catalog presses type etc. **THE KELSEY CO., P-72, Meriden, Conn.**

An Infradyne Combination Set

(*Continued from page 657*)

to the 6-volt "A" battery and are liable to be burned out by improper adjustment of the rheostat R. This should be adjusted so that the meter indicates 3 volts.

Fig. 3 shows a top view of the unit with the four dry cell tubes, V1, and the storage-battery second detector tube, V2, in place. This illustration clearly shows all the parts employed.

OPERATING THE AMPLIFIER

We are now ready to hook the amplifier to a good five-tube set or the equivalent, as shown in Fig. 1. A set having a single dial control like the one shown in the illustration of Fig. 4 is preferable, as this gives only two dials for tuning—the oscillator dial on the amplifier, and the main tuning dial on the set.

Fig. 1 shows the connections between the amplifier and the set. Two of the posts on the amplifier connect to the 6-volt "A" battery, *above the filament switch* of the set, so that when the switch is closed, all tubes light. One binding post connects to the 90-volt "B" battery post of the set. This leaves two more posts to be connected but, first, disconnect the plate of the detector tube in the set from the first stage audio transformer. Then *remove the by-pass condenser*

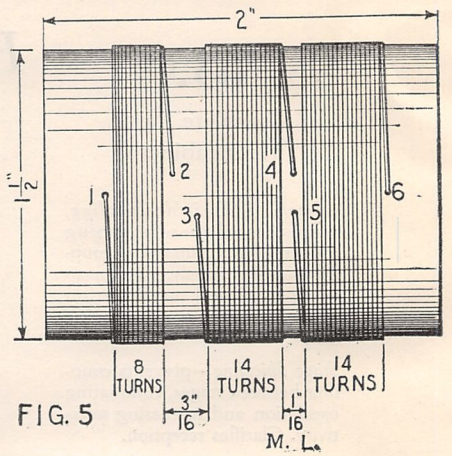


FIG. 5

Details of construction for winding the oscillator coil for this adaptation of the Infradyne amplifier.

from the primary side of this audio transformer, or the tube, to whichever it is connected. Now one of the posts of the amplifier can be connected to the detector plate of the set, and the other can be connected to the primary terminal of the audio transformer, as shown. You now have a ten-tube Infradyne ready for operation. Connected to a good twenty-foot aerial, excellent results should be expected.

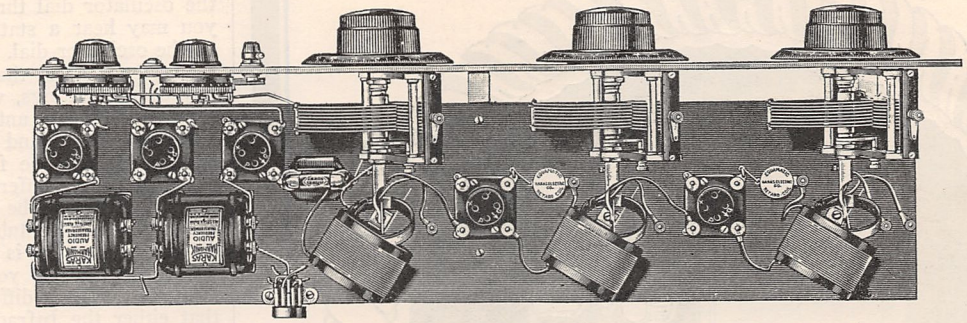
HOW TO TUNE

With a little practice in tuning, and a few possible adjustments of the small knobs on the amplifier unit, you will begin to realize the vast improvement in selectivity and sensitivity afforded by the addition of the unit to your set. Unlike the superheterodyne, stations will be received on only one setting of the dials.

While tuning, do not forget that the capacity of the oscillator condenser is decreased while that of the tuning condensers is increased, and vice versa. On this account, *the dial reading of the oscillator condenser is made just the opposite to that of the tuning condensers.* Although tuning is simplified by the use of a set in which the three tuning condensers are mounted on one shaft, a little practice is necessary before

KARAS EQUAMATIC

The Five Tube Wonder Circuit that has the Whole Country Talking—*Listening*—and BUILDING



HOW would you like to build a five tube radio frequency receiver that brings in every station WITH EQUAL VOLUME AND CLEARNESS from one end of the dial to the other?

How would you like to have a receiver that possesses an ALMOST UNBELIEVABLE SELECTIVITY—that enables you to CUT RIGHT THROUGH powerful local stations—to reach out after DX whenever you want to, WITHOUT THE SLIGHTEST POSSIBILITY OF LOCAL INTERFERENCE, and with an entire absence of scratchy, raspy, so-called static noises?

How would you like to own a receiver whose SWEET, CLEAR, PURE, MELLOW TONES were full-rounded, distinct and NATURAL—never fuzzy, blurry or distorted?

You can have such a set in the KARAS EQUAMATIC. You can easily and quickly build this receiver yourself in a remarkably short time. You can possess THE FINEST RADIO RECEIVER in your neighborhood—one which will out-perform any other set regardless of price or size.

The KARAS EQUAMATIC is something NEW in radio—something BETTER—something more PRECISELY ENGINEERED—something INFINITELY MORE EFFICIENT—than ANY OTHER RECEIVER ever before offered to all who really know radio and who want THE BEST.

It has been rightly called the KARAS EQUAMATIC FIVE TUBE WONDER CIRCUIT. It's a set the like of which radio fans have never before seen.

Engineers who have examined it—who have studied its principle of operation—who have exhaustively tested its performance under every conceivable condition—have been amazed at the manner in which it has SOLVED THE BIGGEST PROBLEM OF RADIO, in a simple, easily understood, AUTOMATIC manner—and solely through its application of absolutely correct engineering principles. Practically every prominent radio magazine in the country is now featuring this circuit.

Radio fans who have built the KARAS EQUAMATIC FIVE TUBE WONDER SET have also discovered that here at last is something entirely new in their whole radio experience—a new kind of TONE QUALITY—a new demonstration of VOLUME AND SELECTIVITY—plus a new principle of AUTOMATIC TUNING that makes all other systems obsolete because lacking in the very essentials that a radio set should possess to be in keeping with present day knowledge and scientific development.

SUPERB TONE QUALITY—AN EQUAMATIC SENSATION

It was no small feat to design a radio receiver in which ALL OF THE MANY PERPLEXING PROBLEMS OF TUNING have been FINALLY and DEFINITELY solved through the invention of KARAS AUTOMATICALLY TUNED INDUCTANCE COILS and other KARAS parts—but it was a STILL GREATER ACHIEVEMENT to produce in the KARAS EQUAMATIC a TONE QUALITY that is ENTIRELY NEW in the field of radio frequency. THE KARAS EQUAMATIC has a marvelous golden tone that has been both the goal and the despair of radio set manufacturers ever since the era of broadcasting began.

You will find in the KARAS EQUAMATIC a quality of richness, fullness and of true tonal beauty. It's tone is never harsh—it is never coarse—just PURE, CLEAR, SWEET MELODY at every wavelength setting of the dials—for EVERY station.

The remarkable tone of the KARAS EQUAMATIC is due to peak efficiency at all wavelengths and to the scientifically correct mechanical and electrical characteristics of the circuit and to the use of KARAS HARMONIK AUDIO FREQUENCY AMPLIFYING TRANSFORMERS, which amplify all of the many vital harmonics and rich overtones that combine to form what we know as audible musical sounds.

EQUAMATIC SELECTIVITY IS UNSURPASSED

Naturally you want a receiver that has the UTMOST SELECTIVITY. In the KARAS EQUAMATIC you will find a complete realization of all you ever have hoped for in this direction. The entire problem of selectivity has been solved by the EQUAMATIC principle, combined with the use of KARAS ORTHOMETRIC STRAIGHT FREQUENCY LINE VARIABLE CONDENSERS and KARAS MICROMETRIC VERNIER DIALS. Because of this remarkable selectivity there is NO OVER-LAPPING OF STATIONS. Each station comes in clear and sharp and full tone at its proper place on the dial.

The selectivity of the circuit is accompanied by a remarkable volume, due to a big gain per each stage of radio frequency and to the employment of the powerful KARAS HARMONIK TRANSFORMERS for the two audio stages.

EASY TO BUILD THIS WONDER SET

Notice in the illustration of the EQUAMATIC RECEIVER how clean cut and easily wired this set actually is. EVEN THOUGH YOU MAY NEVER BEFORE HAVE BUILT A RADIO SET, you can build this one—build it easily and quickly—get from it far better results than you can obtain from the finest and most expensive manufactured set you can buy.

A 16-page manual of simple wiring diagrams and complete instructions for assembling this receiver is packed with each set of KARAS EQUAMATIC INDUCTANCE COILS. In this manual are minutely detailed instructions for the placing of every wire—the making of every connection—the correct positioning of every part. With the aid of this manual and the necessary KARAS parts you can have this wonderful receiver in operation in a remarkably short time. To build the EQUAMATIC RECEIVER you will need the KARAS parts listed on the accompanying coupon, plus other standard parts easily obtainable anywhere.

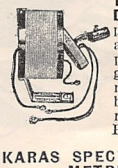
ORDER TODAY FROM YOUR DEALER OR DIRECT FROM US

Thousands of dealers throughout the country can supply the necessary Karas parts for building this powerful, rich-toned and selective receiver. If your local dealer is not able to fill your order, you can secure your Karas parts direct from us by filling out and mailing the coupon. SEND NO MONEY. Just hand the postman the price of the parts plus a few cents postage.

Order your parts from your dealer or from us TODAY. Build one of these sensationally better five tube EQUMATIC RECEIVERS right away, so that you can enjoy all of the pure, rich, full tone qualities—the remarkable selectivity—and the superb volume that it has to offer you in return for a few hours most pleasantly spent in building this totally satisfactory set.

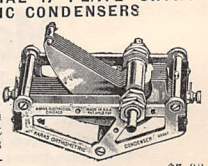
KARAS ELECTRIC CO.
1129 Association Bldg.
Chicago, Illinois

Essential Parts of the Karas Equamatic Sensation



KARAS EQUAMATIC INDUCTANCE COILS are packed three in a carton, and come to you with complete manual of simple diagrams and instructions, all necessary nuts, screws and binding posts, ready for mounting in your receiver. Price, set of three coils, $12.

KARAS SPECIAL 17 PLATE ORTHOMETRIC CONDENSERS



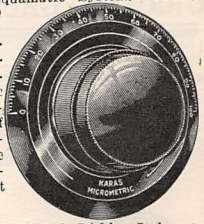
three of which are used in the Equamatic Receiver, have special extended shafts upon which to mount the primary coils of the Inductances. Price, each, ...$7.00

KARAS HARMONIK AUDIO FREQUENCY AMPLIFYING TRANSFORMERS

are essential to the tone quality success of the Equamatic Receiver. Two of these are used for the two stages of audio frequency amplification. Price, each, ...$7.00

KARAS EQUAMATIC RETARD COILS, two of which are used, were designed especially for the Equamatic System. Price, each, ... $1.00

KARAS EQUAMATIC SUB-PANEL BRACKETS. To insure the necessary exact positions of primary and secondary coils these brackets are essential. Price, set of three, 70c.



KARAS MICROMETRIC DIAL. It has a 63 to 1 vernier and tunes to 1/1000 of an inch. **Price, $3.50.**

KARAS ELECTRIC COMPANY,
1129 Association Building, Chicago, Illinois.

Please send me a set of 3 Equamatic Inductance Coils, $12.00; 3 Special Orthometric Condensers with extended shafts, $7.00 each; 3 Micrometric Vernier Dials, $3.50 each; 2 Harmonik Audio Transformers, $7.00 each; 2 Equamatic Retard Coils, $1.00 each; and 3 sub-panel brackets, 70c, for which I will pay postman $60.20, plus postage, upon delivery. It is understood that I have the privilege of returning any of this apparatus for full refund any time within 30 days if it does not prove entirely satisfactory.

NAME.....

ADDRESS.....

CITY.....STATE.....

(If cash accompanies order we will ship postpaid)

Long Life. No Acids or Liquids Better Radio Reception

Majestic "B" Current Supply

delivers pure direct current-From your light socket

Majestic Standard — B
Capacity seven tubes or six plus one power tube. 45 milliampheres at 135 volts.
$32.50
West of Rocky Mts., $35.00

Majestic Super—B
Capacity 1 to 12 tubes, including the use of power tubes, 45 mils at 150 volts.
$35.00 *(As illustrated)*
West of Rocky Mts., $37.50

Majestic Master—B
For Radiola 25, 28 and 30 and Super heterodynes. Operates all power tubes. Rating 60 mil s at 150 volts.
$42.50
West of Rocky Mts., $45.00

Durability . . . . No acids or liquids. Uses Raytheon Tube; no filament to burn out.

Dependability . . Maximum and unvarying power always available.

Better Reception No hum. Superior to any source of power.

Economy . . . . . Low first cost. Cheapest and best form of "B" power. Average cost, 1 cent for 10 hours.

Flexibility . . . . Voltage can be accurately adjusted to meet varying conditions in every city—and on any set.

See your dealer today. Insist on a demonstration on your own set immediately
(Can be purchased on deferred payments)

GRIGSBY ~ GRUNOW ~ HINDS ~ CO. 4572 ARMITAGE AVE. CHICAGO-ILL.

CARTER "Midget" Rheostat with Filament Switch

$1

As soon as knob is turned from "off" position, filament circuit is closed. One less knob on panel, saves space. Resistance element clamped in metal frame. The wire cannot move and short circuit. Smooth, noiseless, compact.

Carter Jack and Switches also specified in Hammarlund-Roberts circuit.

2 ohm* 20 ohm*
3 ohm* 25 ohm
6 ohm* 30 ohm*
(Half size) 10 ohm* 40 ohm
15 ohm 50 ohm*
75 ohm*
*R.M.A. Standard

Any dealer can supply
In Canada: Carter Radio Co., Limited, Toronto

Carter Radio Co.
300 S. RACINE AVENUE
CHICAGO, ILL., U.S.A.

MEMBER R.M.A.

Insure your copy reaching you each month. Subscribe to Radio News—$2.50 a year. Experimenter Publishing Co., 53 Park Place, N. Y. C.

skill in tuning in distant stations is attained. Of course with a two-dial or three-dial set, the process of tuning is the same; you merely have more dials to operate.

On first placing the set in operation, you may have trouble due to harmonics of the oscillator circuit. Such trouble is bound to occur if either the intermediate amplifier or the R.F. amplifier in the set is also oscillating. When in this state a series of heterodyne squeals will be heard, while turning the oscillator dial throughout its range, and you may hear a station on several settings of the oscillator dial. It is important, therefore, to use a set that does not oscillate on any of the settings, with this amplifier.

If you leave the antenna tuning dial set on a given station and revolve the oscillator dial alone over the full scale, you will get three or four different settings for each station. This can be done with any set that uses an oscillating tube. If, by turning both dials together, as is done in the ordinary tuning of the set, you still get the station in three or four different places, it means that either the Infradyne amplifier is oscillating or else you are using too big an antenna. Remember the Infradyne requires only a short antenna, 15 to 25 feet long—no more.

The best way to put this outfit in commission is to set your antenna dial on a moderately loud station and then turn your oscillator over the full scale, noting each place where the station can be heard. One of these will be the Infradyne setting and it may be picked out easily, *because it will be the loudest one.* When you find this, reset the dial on the oscillator so that it reads about the same as the setting on the antenna dial for the same station. Do not overlook the fact that in tuning the set, the oscillator condenser will be at a higher capacity setting, around 200 meters, and will decrease to a low setting as the received wavelength goes up to 550.

Magnetic Fields In Vacuum Tubes

(*Continued from page* 668)

ROTATION OF LINES OF FORCE

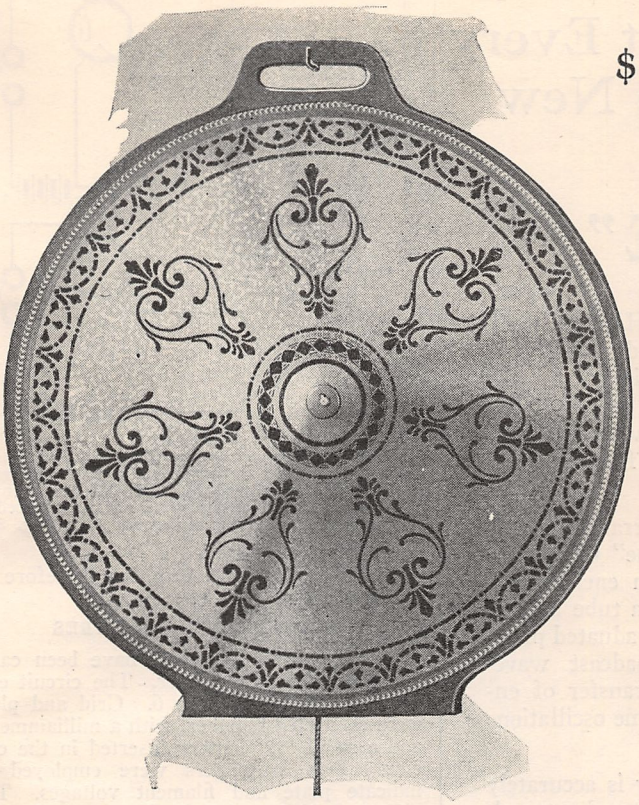
A familiar law of electricity is known as Maxwell's rule; it is that magnetic lines of force, produced by any kind of current, are revolving in the same manner as would a right-hand cork-screw moving in the same direction as the supposed flow of current, from positive to negative. (See Fig. 3).

Another law is that, when two parallel wires are conducting currents flowing in *opposite directions,* they are *repulsing* each other. Fig. 4 shows that the magnetic lines produced are engaged and turn together somewhat as do the teeth of two gears in mesh.

It may, then, be seen that when the magnetic lines of two different systems are disposed in such a way as to revolve together, the result will be an attraction; meaning a tendency to bring the lines moving in the same direction nearer to each other. No attraction or repulsion would result, however, if the two groups of magnetic lines were not in parallel planes.

EXTERNAL AND INTERNAL FIELDS

In Fig. 5 are shown the three possible positions of a magnetic field in relation to the electronic stream of vacuum tubes. In A is indicated the disposition adopted by de Forest and P. Louis, as may be seen from Figs. 1 and 2. The planes of magnetic lines produced by the electrons (as they would be by ordinary currents) and by the coil, are not parallel (they are perpendicular) and



$15.00

(West of Rockies, $18.00)

An astonishingly low price for this 22-inch Windsor Cone Loudspeaker mounted on sounding board and supplied with easel. Can be hung on wall or stood on table or floor.

This Amazing New Cone Speaker Hangs on Wall or Stands on Table!

Model 200
With 22-inch Cone

This Windsor Cone Loudspeaker Console is equipped with a 22-inch Windsor Cone Loudspeaker. Its top is 30" x 17" and is 29" high. The battery shelf provides ample space for batteries, charger, battery eliminator and other equipment. Beautifully finished in either Mahogany or Walnut. Price only **$29.00**

(West of Rockies, $35)

In this Windsor Console is combined both the Windsor Moulded Composition Horn Loudspeaker and the 18-inch Windsor Cone Loudspeaker. The top is 30" x 17" and stands 29" high. Ample battery and equipment space is provided by large shelf in rear. Price finished in Walnut or Mahogany **$48.00**

(West of Rockies $55)

Model 302
With Moulded Composition Horn Loudspeaker and 18-inch Cone Loudspeaker

NOW the radio world enjoys a new sensation—a 22-inch cone loudspeaker mounted on a sounding board and equipped with an easel back so that it can be hung on the wall, stood on a table, or placed on the floor.

• • •

And this is the famous Windsor Cone Loudspeaker that reproduces *all* the tones as they are broadcast. From the deepest throated pipes of the largest organ to the softest note of a crooning lullaby—from full volumed brass of a band playing "The Stars and Stripes Forever" to the last faint note of "Home Sweet Home" played by a master violinist—*every* tone, *every* sound is reproduced with perfect fidelity in all its beauty, just as it entered the microphone.

• • •

This wall and table model Windsor Cone Loudspeaker has no equal in value in the world of radio. When compared with the average cost of cone-type loudspeakers of even smaller size and without the sounding board and easel back, the cost of this Windsor model is amazingly low.

• • •

Dealers everywhere are showing this new radio wonder. Go to your dealer today—see and hear this marvelous loudspeaker—note its extreme utility—compare its low price with others—compare its tone—its volume—then you will have no other. If your dealer should not have one, send your name and address for complete information and prices on the entire Windsor line of Cone and Horn Loudspeakers and Loudspeaker Consoles.

Note to Dealers Write or wire today for details of the highly profitable Windsor selling franchise.

WINDSOR FURNITURE COMPANY

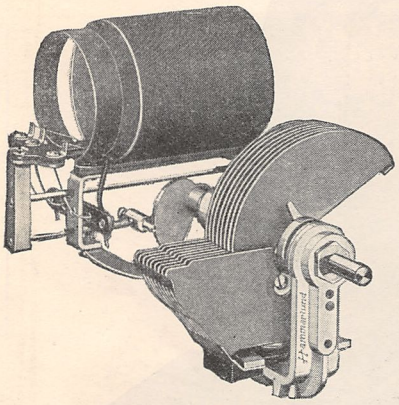
World's Largest Manufacturers and Originators of Loudspeaker Consoles

1410 CARROLL AVE. • • • CHICAGO, ILLINOIS

Los Angeles Branch, 917 Maple Ave.

Accurate Primary Coupling at Every Condenser Setting with the New Hammarlund

"AUTO-COUPLE"



Hammarlund Space-Wound Coils embody the results of years of research for a method of winding the efficient solenoid type of coil, with a minimum of distributed capacity and high frequency resistance. They are wound on a mere film of dielectric material, with a definite space between turns. The wire being firmly anchored to the dielectric, inductance value cannot change, and short circuits are impossible. They may be had for use in neutrodyne and other tuned radio frequency circuits—also for any regenerative circuit requiring a tickler feedback. The superiority of Hammarlund Space-Wound Coils is universally recognized by leading engineers and advanced amateurs.

THE "Auto-Couple"—Hammarlund's latest contribution to radio—has been specified by the designer-engineers for the new Hammarlund-Roberts "Hi-Q" Receiver. It may be used also with equal efficiency in other tuned radio frequency circuits.

It is a scientifically correct arrangement of Space-Wound Coil, "'Midline" Condenser and Aluminum Shield which encloses the complete assembly including a tube and its socket. It gives automatic, graduated primary coupling at every broadcast wavelength, assuring maximum transfer of energy and minimizing unwelcome oscillations on the shorter waves.

The "Auto-Couple" assembly is accurately and strongly built and rigorously tested. For the convenience of set-builders coils, condensers and shields are also sold separately. Condensers which may be used with the "Auto-Couple" are the Hammarlund "Midline" or "S-F-L" .00035 (17 plate) or any other make of condenser having a back extension shaft.

Most good radio stores sell Hammarlund Precision Products—if yours doesn't, write us direct. Descriptive folder on request.

For Better Radio
Hammarlund
PRECISION
PRODUCTS

HAMMARLUND MANUFACTURING CO.
424-438 W. 33d STREET, NEW YORK

FREE New 1927 Catalog FREE

Shows photographs and hook-ups of all latest kits, complete line of cabinets and consoles, accessories and parts. We are headquarters for all nationally advertised lines. Dealers and professional set builders write today for your copy of this big FREE CATALOG.

SHURE RADIO CO., 3—19 S. Wells St., Chicago

$100 a week Selling Shirts

Fred Frankel, Ill., writes: "I earned $110 first week selling Carlton Shirts direct to consumer." You can too. No capital or experience required. We pay 25 per cent. cash commissions daily and big extra bonuses.

WRITE FOR FREE SAMPLES
CARLTON MILLS, Inc., Shirt Mfrs.
114 Fifth Ave., Dept. 169. New York

FREE RADIO GUIDE

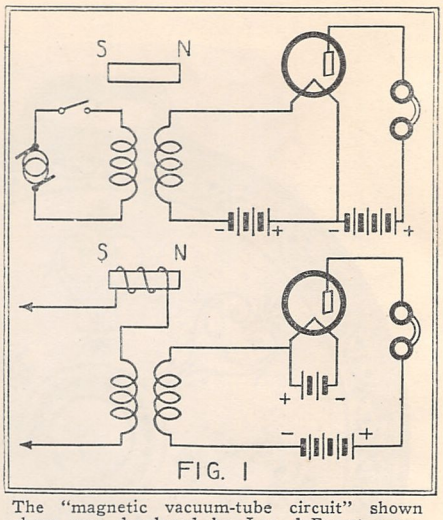
164-PAGE (1927) GUIDE

Gives special hook-ups with illustrations. Shows big savings on standard radio parts, complete sets, kits. Be sure to get this thrifty book before you buy. Write letter or postal NOW. Also include name of another fan.

BARAWIK CO., 542B Monroe St., CHICAGO, U. S. A.

"Lighting Fixtures"
READY TO HANG
(Direct from Manufacturer)
Completely wired including glassware
Send for new Catalogue No. 27
(Just reduced prices)
Special Proposition to Dealers
ERIE FIXTURE SUPPLY CO.
STATION R ERIE, PA.

Insure your copy reaching you each month. Subscribe to Radio News—$2.50 a year
Experimenter Publishing Co., 53 Park Place, N. Y. C.



The "magnetic vacuum-tube circuit" shown above was developed by Lee deForest many years ago. Its effects were not pronounced. This is similar to the circuit shown in Fig. 2.

no action upon the stream can therefore be brought about.

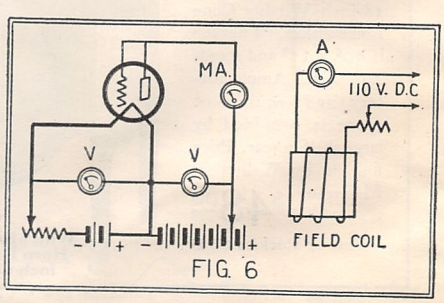
EXPERIMENTS ON TUBES

Arrangements B and C have been carefully tested by the writer. The circuit employed is shown in Fig. 6. Grid and plate were connected together, with a milliammeter and a small "B" battery inserted in the circuit. Two voltmeters were employed to indicate plate and filament voltages. The air-core coil, used for the production of the magnetic field, had 2400 turns and a resistance of 94 ohms. Voltages were employed sufficiently high to obtain fields up to 3000 ampere-turns.

In the case of Fig. 5B, a German Telefunken tube was employed. The figure shows that, according to the rules given above, the electronic emission is so attracted as to describe a small curve in its trajectory towards the second electrode formed by the grid and the plate. This curving of the electronic stream increases its length, and as the speed of electrons remains the same, the number of electrons going to the grid and plate in a given time becomes smaller and the current through the ammeter decreases.

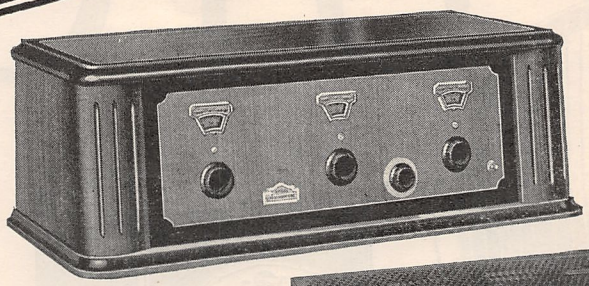
The principle involved is that, the only possible effect of an external field being to *curve the electronic stream,* the *plate current will always decrease* with ordinary tubes. It has never been possible to produce the slightest increase with any feasible form or intensity of fields.

The case of Fig. 5C is somewhat different. Two French tubes were used; the standard 4-80-volt army model, and a smaller receiving tube having a low consumption filament and known as the "Radio-Micro." The experimenter worked quite a long time without knowing exactly what happened to the poor electrons. A very important decrease of current could be noted; but it seemed that it should not have been so important. After many researches the following results were found.

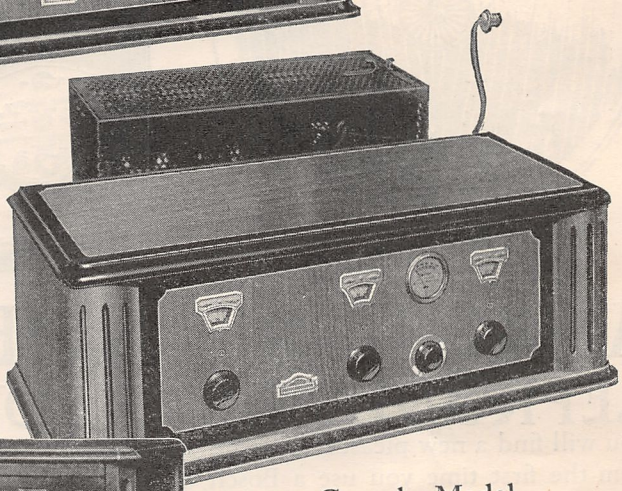


The circuits employed by Mr. Serrell in his experiments. That of the electro-magnet is shown at the right.

Genuine NEUTRODYNES



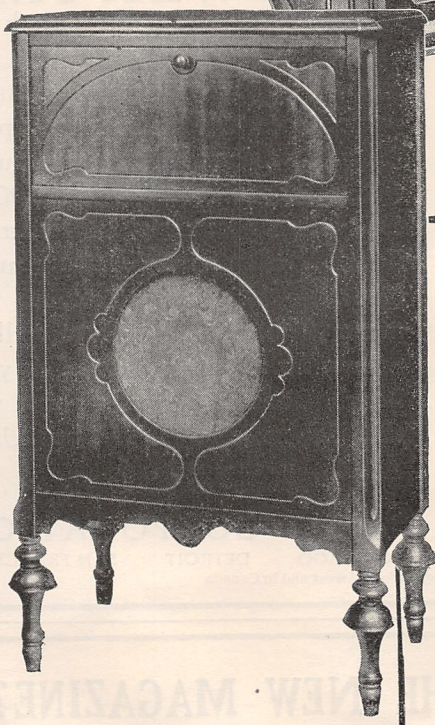
Battery Type
5 Tube S-522
$60



5 Tube
Lamp Socket
Model AC-5

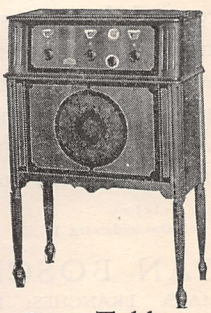
Receiver . . .$65.00
Power Unit . $85.00

$150



Console Model

Equipped with battery type set, 5 tubes . . . . . $110.
With lamp socket set and power unit, 5 tubes . . . . . $200.



Cone Table

For table models S-522 and AC-5 . . . . . $32.

Note how models pictured above make a console unit when used with cone table. Crosley Musicone built in. Matches table models in finish and design. Ample room for batteries or power unit and accessories.

AMRAD achievements in Neutrodyne radio are based on three great ideas,

1. Powel Crosley Jr.'s genius in mass production.
2. Radio set operation direct from a light socket.
3. Use of the famous Mershon Condenser.

Engineering skill and inventive wizardy are of little practical worth until some master of production and organizer of distributing machinery can deliver the product into the public's hands at reasonable prices.

So completely has Powel Crosley Jr. demonstrated his ability to make good radios in great quantities and at high speed that his influence in Amrad affairs already manifests itself in this startling fact — *Amrad Neutrodynes at* $60. — beautifully made and giving wonderful performance. All because of Crosley's purchasing power and standardized manufacturing methods.

Radio Power from LIGHT Sockets

Amrad's crowning achievement. A power unit using current direct from housing lighting fixture to furnish A, B, and C current to the radio. Switch that turns on radio starts AC current from light socket. Snapped off everything stops. No batteries—nothing to charge. An entirely NEW development in power supply. Peak efficiency at all times. This remarkable unit has been TESTED BY CONSTANT USE IN HOMES FOR OVER A YEAR.

The Famous Mershon Condensers

These condensers are of sufficient capacity to store enough energy to supply sudden maximum drains of plate current without distorting musical sounds. Their use eliminates chemical batteries. They have great mfd. capacity with a safety factor of more than 100% beyond demands made upon them in Amrad radios. These marvelous condensers smooth out the alternating current ripple giving continuous direct current where required.

Beautiful Models

Simple of design and rich in the elegant finish of the luxurious mahogany. Fittings are the finest. Dials are recessed behind windows. Delicate vernier controls.

In the console the celebrated Crosley MUSICONE has been skillfully arranged with the front panel forming a baffle board to produce most exquisite tone. There is no distortion or choking from the tremendous power output of the light socket set. Silk screen protects the cone from damage.

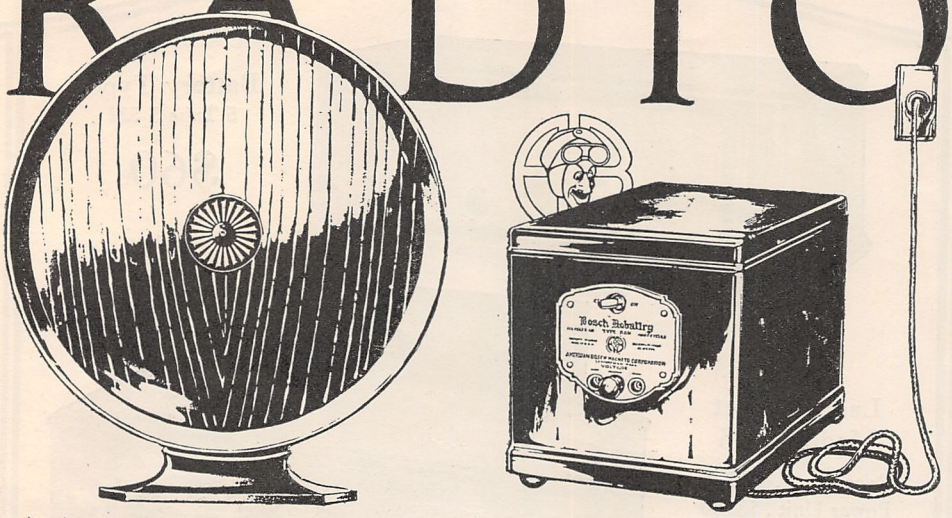
THE AMRAD CORPORATION
MEDFORD HILLSIDE, MASS.
Harold J. Power, *Pres.*

AMRAD

NEUTRODYNES

3 DIAL 5 TUBE

BOSCH RADIO



AMBOTONE REPRODUCER

You will find a new pleasure in radio from the first time you use a Bosch Ambotone Reproducer. The Ambotone is mellow in tone, the mellowness of wood. It is absolutely accurate in reproduction over the full range of orchestral music and the human voice. The wood cone reproducer gives the accepted highest standard of quality in radio reception. The Ambotone will beautify your corner as well as get the best that is in your set. Ask your Bosch Radio Dealer to demonstrate the Ambotone.

Bosch Ambotone $27.50
Art Pedestal sold extra $11.50

NOBATTRY "B" POWER UNIT

NoBattry is just what you have been waiting for—safe for you, safe for any set, cannot burn out tubes, powerful enough for any set up to 10 tubes including power tube, with a capacity range from 90 to 135 volts or better of "B" current. Bosch NoBattry is entirely automatic, no hum, no noises, no filaments to burn, no acids to spill or renew, no adding water. Ask your Bosch Radio Dealer to show you this dependable "B" Power Unit.

For Alternating Current $55
For Direct Current $42

AMERICAN BOSCH MAGNETO CORPORATION
SPRINGFIELD, MASS. BRANCHES: NEW YORK CHICAGO DETROIT SAN FRANCISCO
All prices slightly higher Colorado and west and in Canada

HAVE YOU SEEN THE NEW MAGAZINE?

For Men and Women who want to become Independent

MONEY MAKING

The Magazine of Opportunities

Earn a Second Income

25c ON ALL NEWSSTANDS

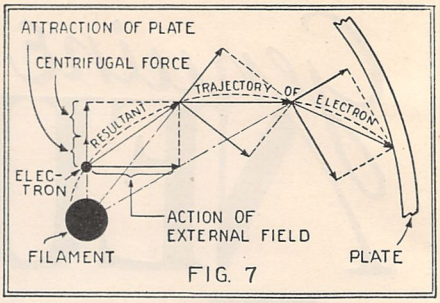


FIG. 7

The resultant of the forces exerted on the electron stream leaving the filament of a vacuum tube under the influence of a magnetic field.

EFFECT OF CENTRIFUGAL FORCE

It would seem, from close examination of Fig. 5C, that the trajectory of electrons should simply be curved in this case as in the other.

It is to be noted, however, that whereas in arrangement B the electronic stream could not follow the external attraction without increasing its length, in that shown at C the shape of the concentric plate allows the stream to follow the attraction due to the external field without losing that due to the plate's positive potential.

This causes the electronic stream to revolve around the filament with a very high speed.

A very good arc lamp has been constructed, using this principle to give stability to the arc. It was invented by Garbarini.

Let us try to find the rotating speed of the stream in the case of the standard French tube:

If we compare the electronic stream to a rigid wire carrying a current, the formula giving the speed in revolutions per second would be:

$$R = \frac{U}{\pi H r^2 10^{-6}}$$ in which:

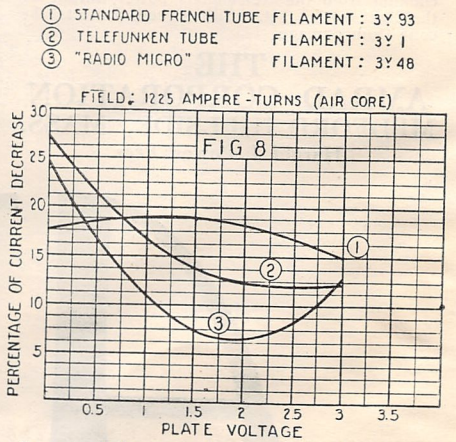
U—voltage of "B" battery in volts;
H—external field in gausses;
r—radius of plate, or length of electronic stream, in centimeters.

This gives about 6500 revolutions for a plate potential of 1½ volts, a radius of 0.4 cm. and a field of 450 gausses, corresponding to 3000 ampere-turns with the coil used.

As the electronic stream cannot be exactly assimilated to a rigid wire, and is necessarily curved (as will be seen later) this result is not quite exact; but it gives rather a good idea of the action.

It has been said that the mass of an electron is 0.8×10^{-27} grams. Infinitesimal as it may seem, the centrifugal force will certainly have a marked action upon this little particle of electricity, if it makes 6000 revolutions per second!

This centrifugal action (which we have reckoned to be about $5^2 \times 10^{-21}$ grams in the



Some typical curves plotted by Mr. Serrell, indicating the variations in plate current in a tube under the influence of a magnetic field, at different plate potentials.

Largest variety of Radio Parts!

1926 EDITION No. 16

300 Illustrations

8-Page log book of all U. S. Broadcast Stations

RASCO HAS IT

RASCO RADIO PARTS CATALOG No 16

Radio Specialty Co

RASCO PRODUCTS 96-98 Park Place New York RASCO PRODUCTS

"ALL GOODS SENT PREPAID IN U.S.A."

THIS 68 PAGE RADIO CATALOGUE FREE

75 HOOKUPS

BUY FROM RADIO'S OLDEST MAIL ORDER HOUSE

WE are the oldest established, exclusive radio mail order house in the country. Our motto is "Quick Shipment." All orders are shipped within 24 hours. Quick, prompt, courteous service. We carry a larger variety of radio parts and findings than any other radio house in the country.

"RASCO HAS IT"

It you are in need of certain small radio parts that other radio and mail order houses do not bother to carry, get the Rasco parts catalog, and you will find them there, anything from a screw to copper ribbon and telephone diaphragms, as well as thousands of other small radio findings. Just to mention a few:

Lugs, nuts, dials, vernier dial, jacks, plugs, every kind of knob, cords, panels, screws, sliders, washers, selenium, tinfoil, switches, crystals, cap nuts, Litz wire, cord tips, brass rods, resistances, name plates, spring binding posts, switch parts, metal ribbon, carbon balls, binding posts, all types, switch points, switch levers, lock washers, carbon grains, ground clamps, metal pointers, insulated tubing, low melting metal, antenna connectors, bus bar wire, as well as thousands of other articles.

We carry the Largest Variety of Small Radio Parts in the World.

THE NEW RASCO CATALOG No. 16

Contains the Following Hookups

All Armstrong Circuits: These important circuits are explained clearly, all values having been given. Just to name a few of the Vacuum Tube circuits: The V.T. as a detector and one-step amplifier; Super Regenerator; one-step radio frequency amplifier and detector; three-stage audio frequency amplifier; short wave regenerative circuits; 4-stage radio frequency amplifier; radio and audio frequency amplifier; inductively coupled amplifier; all Reflex Circuits. This catalog is crammed full of small parts and radio findings, literally thousands of them. In addition there is much useful information contained herein.

If you will paste this coupon on a post card and mail today, we will be pleased to send you our new Catalog at once.

RADIO SPECIALTY CO., 98 Park Place, New York R.N.-12-'26

You may send me, without charge or obligation, your NEW CATALOG No. 16. (Write on margin if you desire.)

.....

.....

Name .....

Street .....

P. O. ..... State .....

RADIO SPECIALTY CO.

98 Park Place **New York, N. Y.**

The New Ferguson

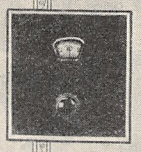
MODEL TWELVE

The Gold Standard of Radio Receivers

WITH the FERGUSON Model Twelve you enjoy *absolute fidelity* of tone. The rendition in the distant studio reaches your living room round, full, *clear*—with all of the original *expression* of the artists. When an orchestra plays, you hear *all* of the notes both treble and bass—the harmony of the whole. The music rests and soothes you—as it should—because the true tone *colors;* all of the countless delicate shadings and overtones; reach you unaltered—in perfect timbre!

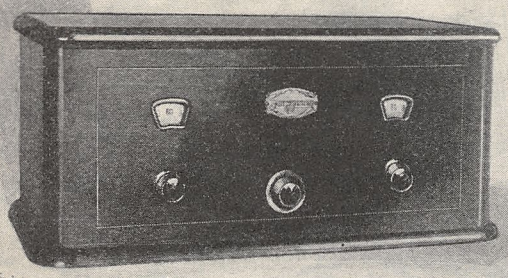
The nearest Authorized FERGUSON Dealer will be glad to let you hear how enjoyable radio can be.

J. B. FERGUSON, INC., 225 West 57th St., New York, N.Y.



The Two Tuning Dials Light when the Receiver is in operation.

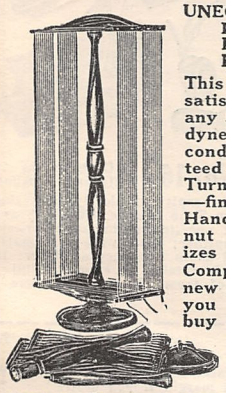
Complete shielding gives this Receiver its Marked Selectivity.



Model Twelve—a precision-built 6-tube FERGUSON, with superb cabinet of graceful lines, $75. (Ten per cent higher West of the Rockies.)

No Seasonal Models—Continually Developing Refinements

New THOMAS Box Type Loop



UNEQUALLED
IN PRICE
IN RECEPTION
IN APPEARANCE

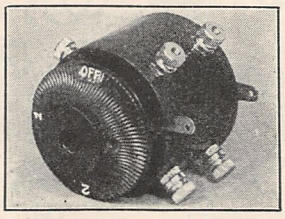
This loop is a highly satisfactory receiver on any 5 tube or superhetrodyne circuit using .0005 condensation. Guaranteed as to workmanship. Turns on a 6-inch radius—fine for small spaces. Hand rubbed, dark walnut finish that harmonizes with any furniture. Compare this wonderful new loop with others and you will not hesitate to buy the THOMAS.

Ask your dealer or send money order direct. Agents, Jobbers and Dealers, WRITE

IDEAL PRODUCTS COMPANY
Manufacturers of Thomas Loops
213 N. Desplaines Street, Chicago, Ill.
($8.50 west of Rockies)

$7.50

Radio's Newest Improvement



The Rono

Multi-Stage Jack and Filament Switch

The Rono eliminates all jacks and push-pull plugs and attendant wiring and soldering. The Rono dial controls the batteries and both audio stages. Each stage a filament control. Recommended by Radio Engineers, Editors and Fans—Single hole mounting—Will outlast the receiver—absolutely efficient—saves time, labor and parts. You will never use another jack after you see the Rono. Get one at your Dealers today.

EACH $2.50

If your Dealer cannot supply you order direct, enclosing $2.50 or we will ship C. O. D.

DEALERS—Write for Discounts—JOBBERS

Rono Mfg. Co., 428 S. Clinton St., Chicago

Insure your copy reaching you each month. Subscribe to Radio News—$2.50 a year. Experimenter Publishing Co., 53 Park Place, New York City.

above case) combined with the attraction of the plate will tend to push the electrons towards the latter.

MEASUREMENT OF CURRENT CHANGES

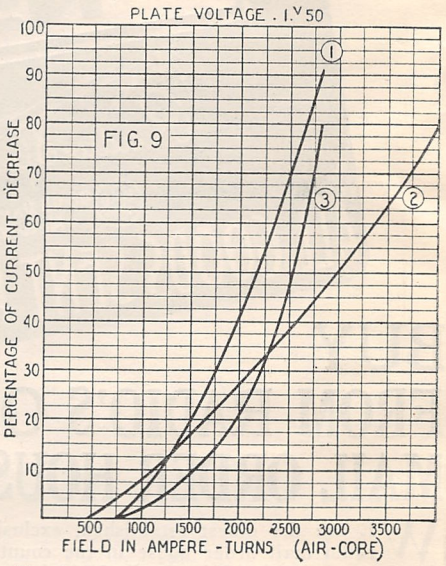
We have therefore, two perpendicular forces. If we trace the parallelogram of these forces we will see that, as shown in Fig. 7 the trajectory of the electrons takes a spiral shape around the filament. To those mathematically inclined, it may be said that the investigations seemed to indicate that this is a hyperbolic spiral curve.

It is now easy to explain the extraordinary decrease of plate current. The electrons having to make many revolutions around the filament before reaching the plate, the stream has considerably more length; and for the reasons given above, there must be a very important decrease of the plate current passing through the milliammeter.

Figs. 8 and 9 give the curves of the percentage of current decrease, for arrangements B and C, with co-ordinates of different plate voltages and of different intensities of fields.

Fig. 8 is very interesting; we can see that the effect of the field is considerably reduced when the plate potential increases but a few volts. Absolutely no perceptible action could be had with the voltage generally employed with ordinary vacuum tubes.

The "radio-micro" tube presents an interesting peculiarity; the decrease of current is greater for a given voltage which is not the minimum (as it is for other tubes). In the case shown, maximum decrease takes place at 1.70 volts on the plate. This may be an explanation of the improvement of detection properties in tubes submitted to external fields. It is easy to see that any inflection point in characteristic curves may bring or improve detection; but only a serious study of the whole matter will give the exact conditions of such detection.



Showing the variation in plate current caused by a change in the relative intensity of the magnetic field to which the tube is subjected.

It may be seen from Fig. 9 that decreases as great as 90 per cent. could be noted, in case C, with French tubes. The curve shows, however, that no action, in any case, could take place with fields under 500 ampere-turns.

LARGE FIELDS REQUIRED

In conclusion, it may be said that such magnetic fields as are found in ordinary receivers could not possibly modify the electronic emission of any tube. Fields of 500 ampere-turns are non-existent in radio reception circuits. This would suppose a current of one ampere in a coil of 500 turns or a current of 1 milliamp. in a coil of 500,-

Five Sets In One Kit

You Can Build Any of These Hook-Ups

And Many Other Famous Circuits

All Using Only TWO CONTROLS with the New

PILOTONE UNIVERSAL KIT

Pilotone Universal Kit Contains

1 Drilled and Lithographed Front Panel (7 x 18)
1 Drilled Sub-Panel (7 x 17)
1 Pilot Light
2 2" Bakelite Sub-panel Brackets
2 700-ohm Resistances (Dampers)
1 .006 By-Pass Condenser
1 .002 By-Pass Condenser
2 Vernier Dials
5 Universal Sockets
1 Filament Switch
1 Pkg. Washers
1 Pkg. Nuts
2 Pkgs. Asst. Screws
38 Flexible Leads
1 .00025 Grid Condenser
1 Grid Leak
9 Marked Binding Posts
2 Audio Frequency Transformers
1 10-ohm Rheostat w/knob
1 20-ohm Rheostat w/knob
1 3-Point Jack
1 4-Point Jack

5 Tube Tuned Radio freq. **3 Tube 3 Circuit**
3 Tube Reflex **2 Tube Reflex**
3 Tube SHORT WAVE

HERE is the kit all set builders have been waiting for. It contains all the parts necessary (except tuning coils and variable condensers) to enable the amateur to *quickly* and *easily* assemble any of these famous circuits. No tools are needed except a screw driver and a pair of pliers. These hook ups are so designed that they all accommodate themselves to the two dial control panel as shown in the illustration. Every enthusiastic fan will want to own this kit. You cannot duplicate the parts at our price and you cannot duplicate layout or plans at any price unless you get at least 5 separate kits. The first demand for these kits will doubtlessly quickly exhaust the immediate supply. *Get your kit without delay.*

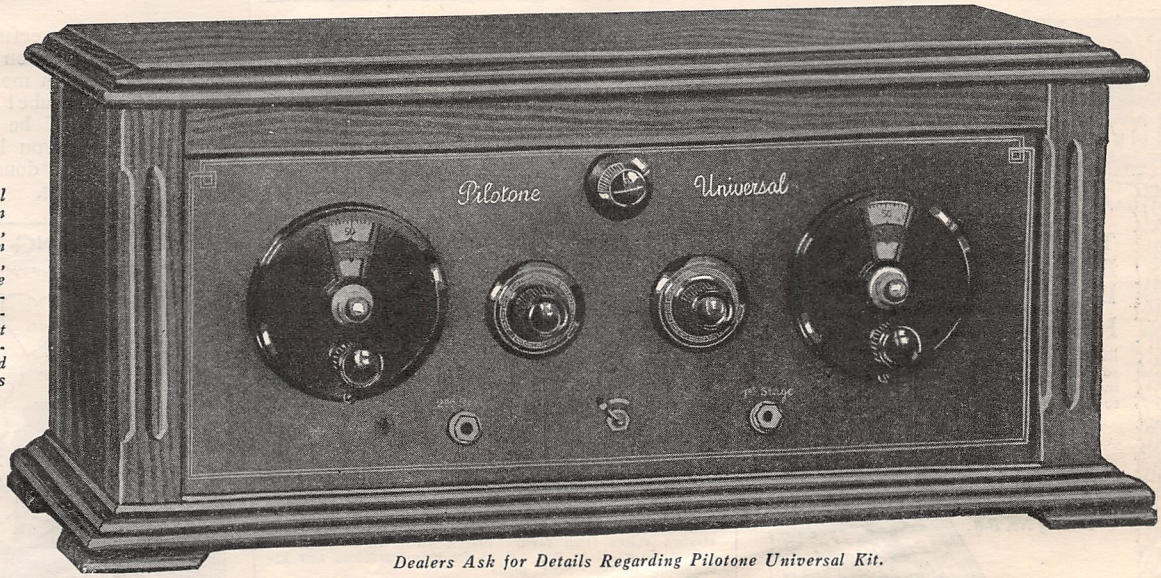
On sale at radio departments of S. S. Kresge Co. stores or if there is no Kresge Co. store in town take THIS AD to your dealer and order through him. The man behind the counter will advise regarding correct Pilot Condensers and coils to be used with this kit. If no Kresge store or dealer is convenient this kit will be sent with catalogue of condensers and coils postpaid upon receipt of .....

$17.90

Handsome walnut finish cabinet send $7.50 additional.

Send Post Office or Express money order. .Address•Dept. 1226

PILOT ELECTRICAL MANUFACTURING CO.
323 BERRY STREET **BROOKLYN, N. Y.**



Pilotone Universal Kit is the creation of Merle Duston, head of the Duston Radio Laboratories, Detroit, Mich., one of the world's leading radio authorities. Each circuit was built and successfully operated before the kit was placed on sale.

Dealers Ask for Details Regarding Pilotone Universal Kit.

Made By Worlds Greatest Radio Parts Manufacturer

Wondering what to give Dad or Sonny for Christmas?

Why not surprise him with a cabinet for that radio set he has made? He's mighty proud of that set and would certainly appreciate a beautiful, genuine mahogany radio cabinet that would lift it above the "home made" class and give it the appearance of one of the finer sets. And the cost of **Baker Radio Cabinets** is not prohibitive for they come as low as $8.00.

Send NOW for our free booklet describing **Baker Radio Cabinets** in detail. Place your order early and be assured of Christmas delivery.

free

The BAKER YACHT BASIN, INC. Quincy, Mass.

Please send me your free booklet describing Baker Cabinets in detail.

Name .....

Address .....

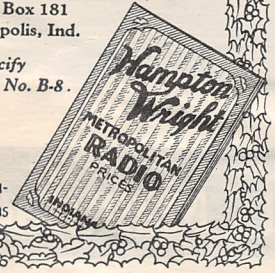
Write for Hampton-Wright Free Radio Catalog

The Book That Means A Better Radio Christmas To Every Set Builder and Fan

HAMPTON-WRIGHT offers only fine radio equipment — the catalog lists hundreds of parts, sets and accessories that will appeal to every one interested in radio. NOW is the time to write for this great radio book.

HAMPTON-WRIGHT, Inc.
P. O. Box 181
Indianapolis, Ind.

Specify Catalog No. B-8.



Make this a Hampton-Wright Radio Xmas

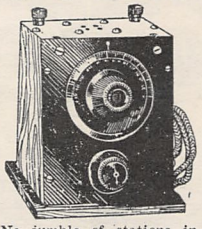
NOW—ANY SET CAN GET

LOW WAVE

Stations—Amateurs

Experience a new radio thrill! Explore the short waves on which super-power stations are experimenting daily and amateurs are talking from all parts of the globe. Enjoy a new radio delight with the

SUBMARINER



Converts Any Set Into a Low Wave Receiver

Gets the Short Wave Experiment Stations broadcasting on 41 meters, 63 meters, etc., and a wide band of Amateurs' Stations.

Price, $15. No extras needed. Anyone can attach in one minute, ready to operate.

Everywhere— a Sensation!

No jumble of stations in the low waves—no disagreeable noises. Ideal for summer reception. Hear KDKA talking to Europe. Listen to an A. R. R. L. operator speaking to Australia! The low-waves abound with new wonders and strange voices from far-off places. The SUBMARINER brings them all to you. Send for this marvelous new instrument **today.** Sent postpaid upon receipt of $15, or C.O.D., plus postage. State type of **detector** tube in your set. Money back if not delighted. Order at once.

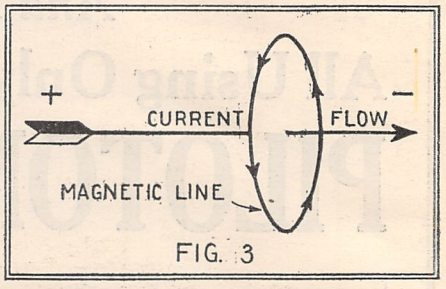
ORDER DIRECT MONEY-BACK GUARANTEE

J. M. P. MFG. CO.

Dept. 115-X **Milwaukee, Wisc.**

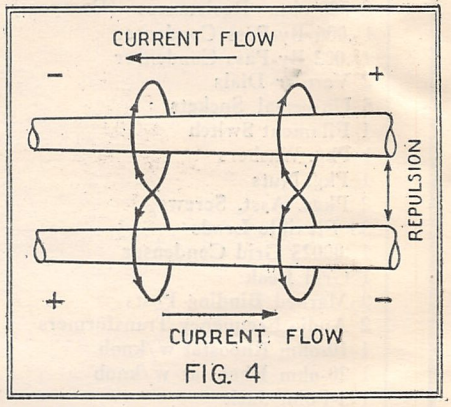
000 turns! On the other hand, plate voltages never are less than 18 or 20 volts. This is amply sufficient to give enough speed to the electrons to overcome the effect of very high external fields.

This is not to say that the use of either permanent or electro-magnets cannot improve detection. These investigations were not carried far enough to give the real conditions of that sort of detection. Certainly it seems possible; but great difficulties may be encountered by those who try to use this system to effect continuously good reception.



Illustrating "Maxwell's rule," by which the direction of revolving magnetic lines of force is conveniently remembered.

Don't be afraid to put your tubes near audio-frequency transformers; but remember that, even if audio or radio frequency fields cannot affect the electron flow in a tube, the R.F. fields at least can disturb the oscillating conditions and cause losses in any radio-frequency circuit.



This illustrates the repulsion between parallel conductors, when the currents flow in opposite directions.

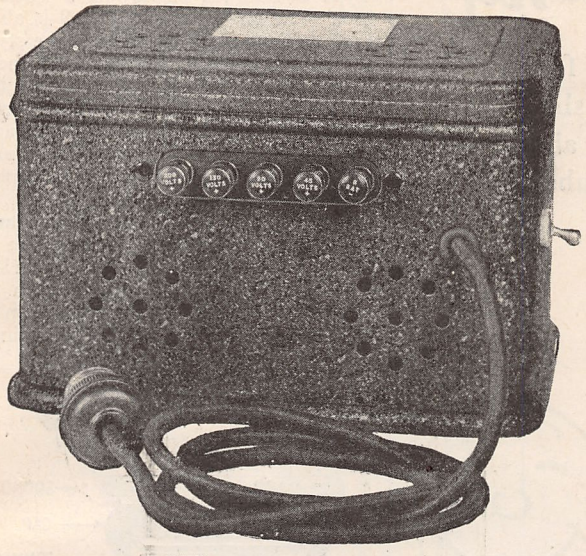
Do not buy powerful and heavy magnets, for use in connection with your detecting system, to bring in more DX stations. Better buy another tube!

Perhaps it will be given to the writer some day to let you know what he thinks can and should be done along the lines covered in this article.

FOR ALL STANDARD MAKES AND CIRCUITS

OF RADIO RECEIVERS

THE TYPE 405 PLATE SUPPLY



IMPROVED quality of reception, free from anxiety caused by steadily deteriorating "B" batteries is now possible thru the use of General Radio—Raytheon plate supply.

This unit operates on 110 volt (60 cycle) A.C. and provides voltages of 45, 90, 130 and 200.

Voltages are readily adaptable to all popular makes and circuits of radio receivers by means of fixed resistances which are tightly sealed from dust and moisture, thus eliminating bothersome and noisy tendencies of variable resistance voltage controls. The unit is contained in a metal case with attractive black crystalline finish, and has a conveniently located A.C. switch.

Price, with BH Raytheon Tube.....$46.00

Ask your dealer to demonstrate this unit or write for Bulletin 925-M.

GENERAL RADIO CO., Cambridge, Mass.

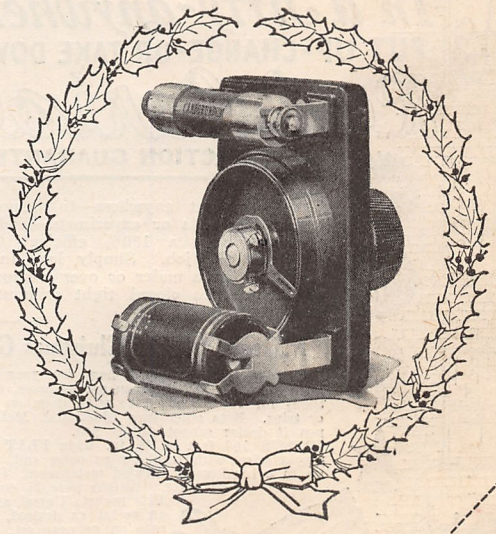
GENERAL RADIO

PARTS and ACCESSORIES

Increased Selectivity
Greater Distance
More Volume

BUT ABOVE ALL—

Quality of Tone



On any set from the modest little Crystal Hook-up to the Super Outfit—you simply install

THE CARBORUNDUM STABILIZING

Reg. U. S. Pat. Off.

DETECTOR UNIT

$3.50 (in U. S. A.) Dealer or Direct

Our Hook-up Book tells you how—send for it

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.

SALES OFFICES AND WAREHOUSES IN

New York : Chicago : Boston : Philadelphia : Cleveland : Detroit : Cincinnati
Pittsburgh : Milwaukee : Grand Rapids
The Carborundum Co., Ltd., Manchester, Eng.

Carborundum is the Registered Trade Name used by The Carborundum Company for Silicon Carbide. This Trade Mark is the exclusive property of The Carborundum Company.

The Carborundum Company
Niagara Falls, N.Y.

Please send free Hook-Up Book D-1.

Name_____

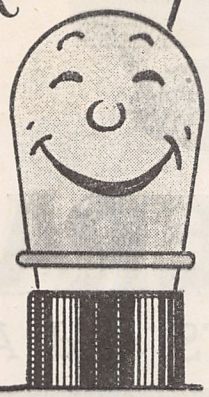
Street_____

City_____ State_____

it takes you less than one second

to end microphonic howling for once and all! That's when you slip one of these live rubber "howl absorbers" over the offending tube.

Mc DONALD HOWL ARRESTER

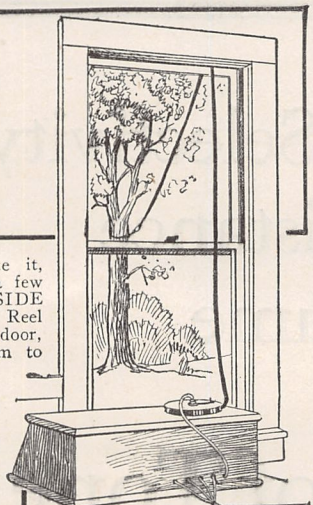


remember this name! You can get it for every size tube. Just ask your dealer, or write

Sole Selling Agents for the U. S. A.
SPARTAN ELECTRIC CORP.
350 West 34th Street, *New York City*
Manufactured in the U. S. A. by
Scientific Products Canada, Ltd.

Price 75 cents each
"It Stops that howl"

In a Jiffy-anywhere
PUT UP-CHANGE-OR TAKE DOWN
Reel Aerial
SATISFACTION GUARANTEED

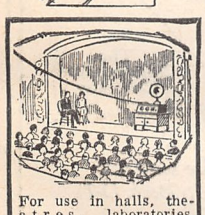


Take your set anywhere—to demonstrate it, entertain friends or experiment—and in a few moments have a 100% efficient OUTSIDE aerial on the job. Simply lead in the Reel Aerial Antenna under or over window or door, which may be closed tight without harm to wire.

Makes a "REEL" Christmas Gift

Something different and new for your radio friends. An aerial they can use at home, change about for testing and take with them on visits or trips. Note other uses illustrated. Mail coupon if dealer cannot supply you.
HERE'S 100 feet of ¼ in. wide FLAT bare, copper wire, with insulator on outer end, reeled up in a handsomely nickled metal case, 4½ in. diameter. Weighs only 21 ounces. Fits pocket. Unreel as long an aerial as desired, place case on or near set, insert plug on cable in center hole—attach other end of cable to set—and tune 'em in. Unused portion in case does not cause dead end losses. When through reel in like a tape measure. No tangling. Provides 100% efficient aerial in a few moments—any time, any place—in doors, out doors.

UNSURPASSED PERMANENT AERIAL! Reel Aerial antenna has same inductance value as stranded copper wire. Being flat, smooth, and easy to take down, it is easily cleaned.



For use in halls, theatres, laboratories, schools, clubs, on trains, at fairs, etc.

PAT. APPLIED FOR

½ Size Illustration
Actual size of Case 4¼ in. diameter

For indoor aerials—can be put up around walls or reeled out on floor.

DEALERS! JOBBERS!
Write for attractive proposition. Use Reel Aerials in making trial demonstrations. Sell Reel Aerials for indoor aerials, portable sets, to travelers and tourists, to experimenters and to people desiring highly efficient permanent aerials.

Experimenters, Engineers!
Attach Reel Aerial insulator to a pole and push pole into ground. Bring antenna into house. By changing distance and locations of pole, and reeling antenna in or out you can vary antenna.

SEND NO MONEY, JUST MAIL COUPON
HAWKEYE RADIO CO.,
Dept. 1412, Cedar Rapids, Ia.
Ship me—on your MONEY BACK GUARANTEE—one Reel Aerial C.O.D. I will pay postman $5 plus few cents postage (postage prepaid when money accompanies order).
Name .....
Address .....

Electrifying Your Phonograph

(*Continued from page* 631)

type of sound box at hand. The illustration of Fig. 8 shows a pick-up unit made from a Type C Baldwin phone and a Pathé sound box. The one shown in Fig. 9 is also made from a Type C phone, but has the stylus and stylus arm mounted directly on a metal cap. The tone arm fitting can be seen on the side. This particular pick-up is of a special type not adaptable to the usual phonograph. The one shown in Fig. 8, however, was made for use on the usual type of phonograph employing lateral cut disc records.

The circuit diagram for the home-made pick-up is shown in Fig. 10. The volume control is an ordinary type of variable resistor (0 to 500,000 ohms), such as employed in radio sets for stabilization or volume control. The 1-mf. blocking condenser can be left out if the device is to feed directly into the primary winding of an audio-frequency transformer, which is not connected to the detector tap of the "B" battery.

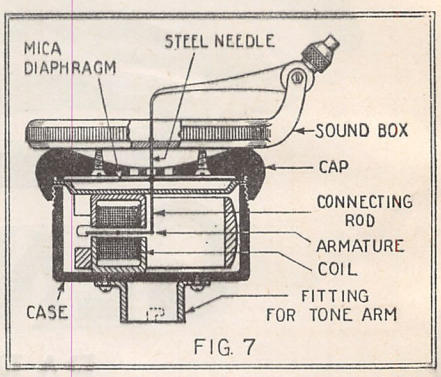


FIG. 7

Constructional details of the home-made "pick-up" shown in the illustration of Fig. 8.

THE AMPLIFIER

To obtain the very best results from any of these electrical reproducers a three-stage resistance-coupled audio-frequency amplifier with a power tube in the last stage should be used. It is then possible to get the most out of the low notes and overtones. However, a three-stage impedance-coupled amplifier or a two-stage transformer-coupled amplifier with a power tube in the last stage in either case will give excellent results, almost equalling the resistance-coupled amplifier. Plenty of volume can be had from any of the amplifiers mentioned if 135 volts "B" battery is used on the last tube. No doubt the amplifier in your radio set will prove entirely satisfactory. Otherwise it is worth while to construct an audio amplifier especially for use with the electrical reproducer, using two of the new type audio transformers or a three-stage resistance-coupled amplifier unit.

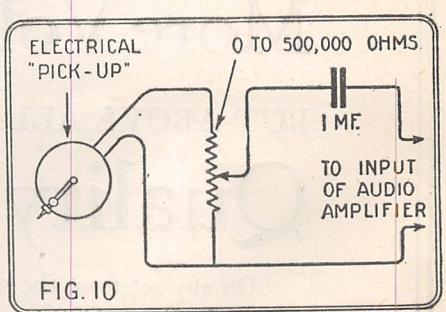


FIG. 10

Wiring diagram for the home-made pick-up (Fig. 8). The output may be connected to any type of audio-frequency amplifier.

New Television Apparatus

(*Continued from page 627*)

what we have said it will be seen that each of the magnetic fields which they produce will have the effect of displacing the stream of electrons in exactly the same way that the luminous ray is displaced by the oscillating mirrors at the transmitter. As these movements of the receiving spot of light are performed under the direct control of transmitting apparatus (alternator and microphone) synchronism is secured in a rigorous degree and the reproduction of the picture at the transmitting station can be obtained on the screen of the oscillograph. The illustration, Fig. 6, shows that this screen, which is placed horizontally upon the oscillograph, has been adjusted there so that a prism reflecting the beam gives a slightly inclined image which is easier to observe.

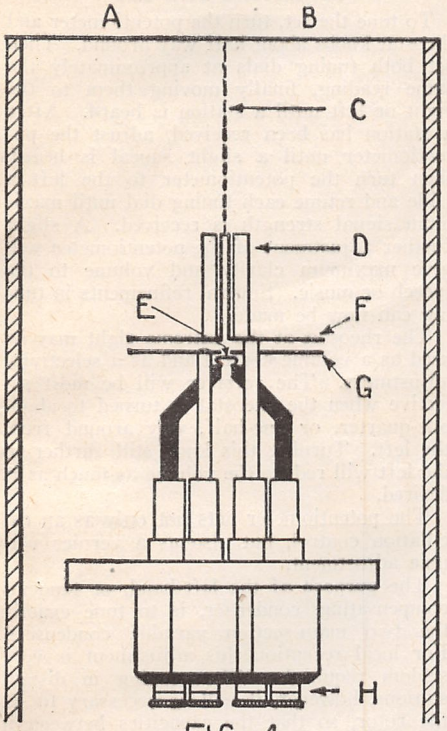


FIG. 4

The Holweck apparatus: A-B is the fluorescent screen on which the electron stream, C, traces a line of light; D is the concentrating coil; E, the filament; F, the plate; G, the grid; H, terminals for the supply circuit.

Up to the present time, Messrs. Belin and Holweck have only tried their apparatus on pictures without half-tones; that is to say having only black and white areas. It is the first step towards the transmission of an image printed in half-tones, such as is used

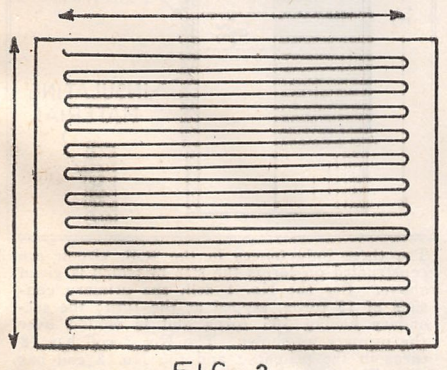
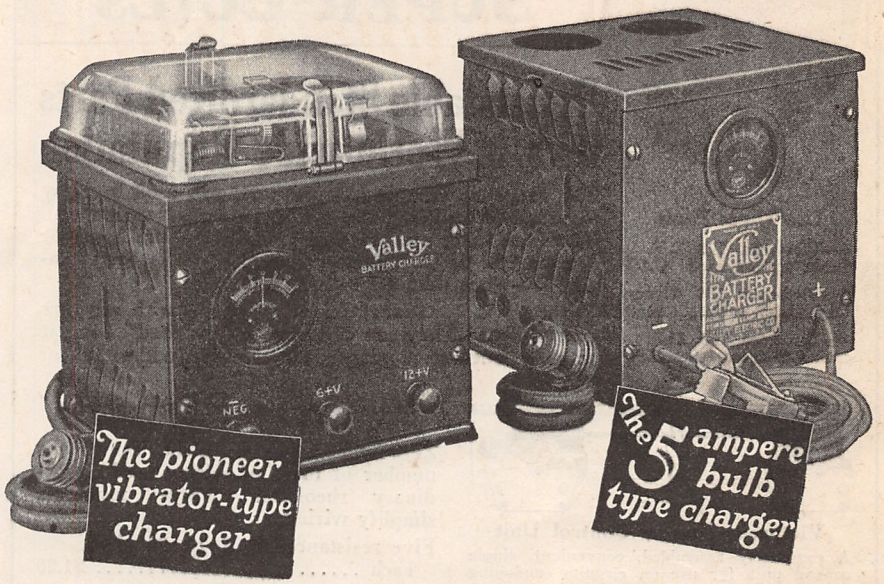


FIG. 2

Fig. 2. Due to the oscillations of the two mirrors, the beam of light follows a zig-zag path across the screen as indicated above. It oscillates horizontally 500 times per second, and vertically 10 times per second.

Valley Electric



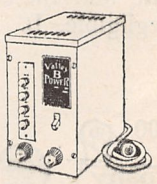
Use either one for a dependable source of "A" battery current

You can get the famous Valley Battery Charger in both vibrator and bulb types. Use either one for a dependable source of A battery current.

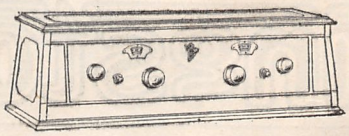
The Vibrator Type: This is the pioneer of radio battery chargers. Nearly a quarter of a million of this type of Valley Charger has gone into service all over the world.

Charges 6-volt batteries at 6 amperes, 12-volt batteries at 3 amperes, Quiet. Efficient. Cannot harm the battery.

Mounted in black case with bakelite panel and glass top. Pleasing in appearance and will harmonize with finest radio receiver. Complete with cord and plug, and leads and clips.



The Twin Bulb Type: The twin bulb design of this Valley Charger overcomes the only objection to the bulb type charger, i. e., the slow charging rate.



Using both bulbs, you have a 5-ampere charger. Using only one bulb, you have a 2½-ampere charger. Thus the charging rate and the purchase of one bulb or two are entirely optional.

Absolutely noiseless. Built in handsome black grained metal case. Complete with cord and plug, and leads and clips.

Other Valley Radio Units

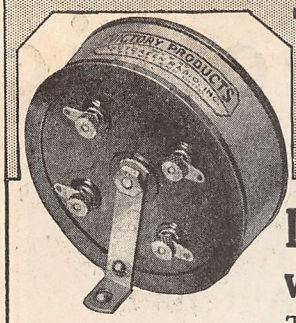
The two small cuts below show the Valley B Power Unit and the Valley Radio Receiver.

The B Power Unit supplies plate voltage from the house circuit. For sets of 12 tubes or less. May be used with a power tube or unit. Fitted with the Raytheon Tube only—"for reliable reception."

The Valleytone is a 5-tube, tuned radio frequency receiver. Two-dial control. Wired so that use of power tube is optional.

VALLEY ELECTRIC CO. · RADIO DIVISION · ST. LOUIS, MO.

District Offices: Boston, Chicago, Cleveland, Indianapolis, Kansas City, Minneapolis, New York, Philadelphia, San Francisco



VICTOREEN SUPER COILS

Dependable Standardized Parts with a World-wide Reputation

The fact that Victoreen Super parts are used in many thousand sets all over the world is proof of their merit. Victoreen Super sets are free from oscillation, howls or squeals. Their "B" Battery consumption is exceptionally low—less than some three tube sets.

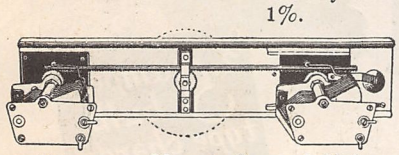
Victoreen R. F. Transformers are made with air core construction. They are not merely "matched" but are actually tuned to a guaranteed precision within 1/3 of 1%.

Use These Parts

4—Victoreen 170 R.F. Transformers, each $7.00

1—Victoreen 150 Coupling Unit, each.... 5.50

1—Victoreen 160 Antenna Coupler, each 3.50



Victoreen Master Control Unit

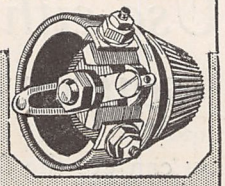
A completely assembled, convenient, single control unit for use on circuits employing two or more condensers of the same capacity. Easy to mount. Simplifies tuning. Victoreen Master Control Unit Type V. S. $19.50
Extra condenser, each 4.50

Victoreen Rheostats

Zero temperature coefficient. Double the number of turns of wiring used on ordinary rheostats. Three terminals simplify wiring.

Five resistances, 2, 6, 10, 20 ohms, each $1.20

Potentiometers, 200 and 400 ohms, each $1.50

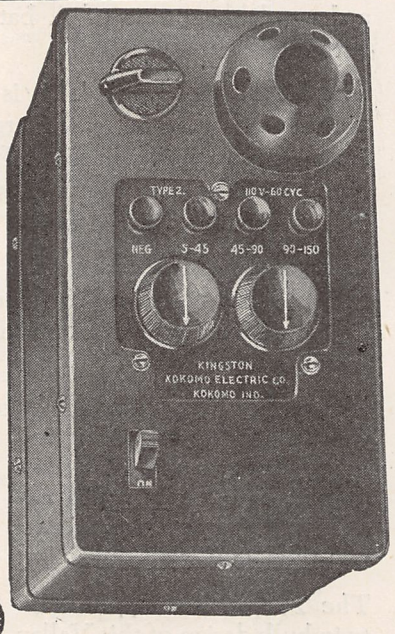


The Geo. W. Walker Company
6528 Carnegie Ave., Dept. H, Cleveland, Ohio
Merchandizers of Victoreen Radio Products

For Better Reception

THE KINGSTON 'B' BATTERY ELIMINATOR is compact, trim, handsomely finished in black and nickel and guaranteed not only to remove the battery nuisance, but to deliver clearer tone and increased volume. With the Kingston three different voltages are obtainable at the same time, each tap adjustable over a wide range, making any desired voltage from 5 to 150 possible and harmonizing perfectly with your own set. The Raytheon tube is used as a rectifier. The Eliminator operates without noise or vibration and will not heat, contains no acid or solution, is no trouble to operate and the operation cost is so low as to be negligible. It will not get out of order.

At Your Dealer's



Price, Complete with Raytheon Tube - - $35.00

Kokomo Electric Company
Kokomo, Indiana

Kingston

FREE RADIO GUIDE

164-PAGE (1927) GUIDE

Gives special hook-ups with illustrations. Shows big savings on standard radio parts, complete sets, kits. Be sure to get this thrifty book before you buy. Write letter or postal NOW. Also include name of another fan.

BARAWIK CO., 542B Monroe St., CHICAGO, U. S. A.

DEALERS!

Complete stock of nationally known parts and accessories. Send for illustrated catalog and discount sheet.

Radio Exclusively Since 1921

CLARK & TILSON, Inc.
122 CHAMBERS ST. New York
The Nationally Known House

in ordinary projection. When this purpose is attained, it will be possible to transmit a moving picture film and to receive it by radio on another film, which can be projected under ordinary conditions.

This will be the first heat in the television race.

The Improved "Bass Note" Circuit

(*Continued from page* 659)

OPERATING THE SET

To tune the set, turn the potentiometer and rheostat knobs about half way around. Then set both tuning dials at approximately the same reading, finally moving them to the right or left until a station is heard. After a station has been received, adjust the potentiometer until a slight squeal is heard, then turn the potentiometer to the left a trifle and retune each tuning dial until maximum signal strength is received. A slight further adjustment of the potentiometer will give maximum clarity and volume to the speech or music. Several refinements in tuning can now be made.

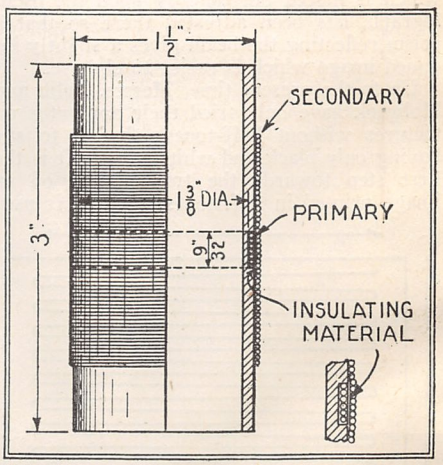
The rheostat at the extreme right may be used as a volume control and as a selectivity adjustment. The receiver will be most selective when the rheostat is turned to about one-quarter, or one-half, way around from the left. Turning this knob still further to the left will reduce the volume as much as is desired.

The potentiometer acts not only as an oscillation control, but also as a vernier volume adjustment.

The purpose of the left-hand, or tandem-compensating, condenser, is to tune exactly the two main-section variable condensers. For local reception this adjustment is very seldom required. When tuning in distant stations, however, it will be necessary to set the rotor, so that the capacities between it and the two sections of the stator are equally distributed.

In other words, the rotor should be in neutral position. After the distant station has been located on the dial, the knob controlling this condenser should be turned to either the right or left, as will be quickly indicated when this adjustment is made. A careful adjustment of this condenser will bring in distant stations with maximum volume.

The small balancing condenser within the set can be adjusted once and when this



The three inductances in the R.F. circuit are constructed on forms the size of which is given above. For the No. 1 coil, the primary consists of 15 turns, tapped at the 10th; the secondary having 105 turns and is wound over the primary as shown. The No. 2 coil has 18 turns in the primary; and the No. 3 coil has 15. The secondaries of all these three coils have the same number of turns, 105. The primaries are wound with No. 30 D.S.C. wire and the secondaries with No. 26 D.S.C. wire. The tap in the No. 1 primary is for a long antenna; the entire coil being used for a short one.

adjustment is made, need not be touched again. The adjustment should be made when receiving a station that tunes in at about 50 on the dials. If the dial settings are not identical, the right-hand one will be high. Turn the right-hand condenser so that the dial readings agree with the dial readings of the left-hand condenser; and then adjust the small balancing condenser until the station comes in again with maximum volume. This setting of the condenser will be satisfactory for all points on the dial.

Short-Wave Receiver Operation

(*Continued from page 678*)

length or using a small series condenser. In the case of the amateur who employs the same antenna for both transmitting and receiving, this cannot be done, but a separate antenna for receiving always gives better results anyway.

THE SCHNELL CIRCUIT

The three-coil circuit employing the awkward, moving tickler coil has been almost entirely done away with of late and the "Schnell" circuit substituted. This circuit employs a variable by-pass condenser or throttling condenser, in conjunction with a fixed tickler coil for regeneration control. This circuit is shown in Fig. 1 and Fig. 2. Fig. 2 shows how the primary may be replaced by a small series condenser of the proper value. This capacity, if used, should be two small plates of brass or copper, to allow soldering, about ½-inch square, mounted on binding-posts about an inch apart. A wire soldered to one of the plates and passing through the hole in one of the screws serves as the variable capacity adjustment and the correct distance is about half an inch. This capacity must be readjusted and its setting is dependent upon the antenna used. For the experimenter this is sometimes objectionable. A primary coil of about 3 turns gives the same results, and practically all short-wave receivers employ one.

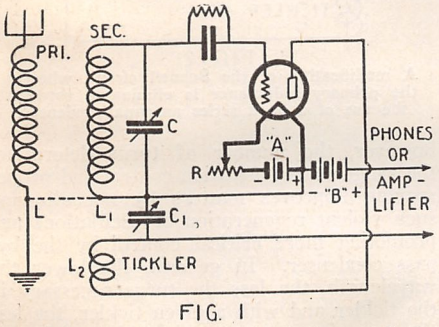


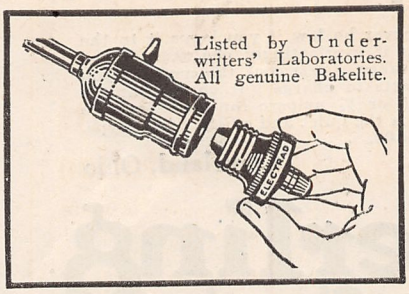
FIG. 1

The Schnell circuit, which employs a fixed tickler coil and a variable by-pass condenser.

The process of assembling a receiver is not difficult but making it function on the proper wave is another matter. Perhaps it may be to advantage to outline this procedure in the following paragraphs.

The selection of the proper inductance for the particular wave-band is perhaps the first consideration. This should not be an ordinary "vario-coupler," "honey-comb," or any of the favorite coils ordinarily in use on the longer waves; but preferably a space-wound coil of say 2¾ or 3 inches in diameter and made of about No. 20 wire. Smaller wire may be used, perhaps, but No. 20 will serve and furnish the proper rigidity. The familiar "collodion-celluloid" space-wound coils, now very popular with short-wave enthusiasts, are excellent for this purpose and are quite readily constructed.

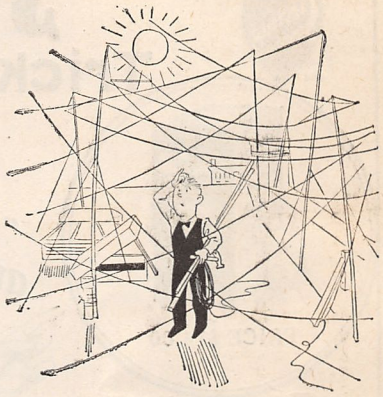
ELECTRAD



Listed by Underwriters' Laboratories. All genuine Bakelite.

SAFE—

Just Plug In--That's All, No Trouble with This Antenna

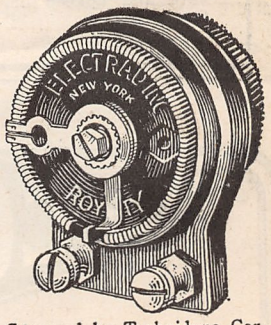


No trouble putting up an aerial. Just plug in on any electric light socket. No inconvenience or interference from neighbors' sets and aerials. Also smothers static and helps get distance. Uses no current. Perfectly safe to use. Tested and certified electrically. The simplest, neatest and most efficient on the market.

At all good radio stores, or they can easily get it for you. Price U. S. 75c, Canada $1.10.

The *New* ELECTRAD

Royalty Variable High Resistances



Licensed by Technidyne Corporation under U. S. Pat. No. 1593685, July 27, 1926.

Leading radio authorities endorse and recommend these improved high resistances—11 types—a range for every purpose. All ranges dissipate 3 watts. Note these important features.

Resistance element not exposed to any mechanical operation.

Metallic arm on wire-wound strip insures positive electrical contact.

Same resistance always obtained at same point.

Resistance value under control in process of manufacture—remains constant in use.

Shaft is turned smoothly over entire range of resistance with less than a single turn of the knob.

Type E—$2.00; all other types, $1.50.

If you have an Outdoor Aerial demand the Genuine Electrad Lead-In

Copied and imitated, but the quality never approached. Triple-ply insulation—full 10 inches long. Fahnestock clips, all connections riveted and soldered. Fits under locked windows and doors. Bends to any shape. Saves walls, windows and door trim. Price, U. S., 40c. Canada, 60c. at all good radio stores.

ELECTRAD Inc.

Forget your battery charging problems!

YOUR storage "A" Battery need never be low if you leave it to the Sterling Trickle Charger to keep it everlastingly charged. When you're using your set this charger takes a rest, but the moment you "turn off" the radio the charger starts to charge. It charges at the steady 2/3 ampere rate for 6-volt A or ½ ampere for 4-volt, a safe slow rate with automatic cut-off. It is the quiet and efficient bulb type. Sterling, meter equipped. Price, $14.00.

THE STERLING MFG. CO., Cleveland, Ohio

RADIO PROTECTION Sterling

Sterling Trickle Charger

PRICE $14.00

No. R-102
Bulb Type
Trickle Charger

Show this ad to your dealer. If he hasn't the Sterling Trickle Charger in stock he can get it for you.

Ask for our 32-page booklet on care and upkeep of radio — it's free!

CORWICO

RADIO'S BEST WIRE

"From the Ground Up"

Corwico Products

Antenna Wire (Solid, Stranded and Braided	Annunciator Wire
Magnet Wire	Flexible Wire
Bus Bar Wire	Lead-in Wire
Hook-Up Wire	Litz Wire
	Loop Aerial Wire
	Battery Cable

Every spool or coil of Corwico Wire is guaranteed full weight, full length, full gauge best grade of copper, insulated with the best materials obtainable, free from all defects and up to the highest specifications in every respect.

Ask Your Dealer for Corwico Wire

FREE Write for interesting booklet, telling all about the various kinds of radio wire and their uses.

Dealers and Jobbers—Write for the "Corwico" wire proposition.

CORNISH WIRE COMPANY

30 Church Street New York City

FREE RADIO GUIDE

164-PAGE (1927) GUIDE

Gives special hook-ups with illustrations. Shows big savings on standard radio parts, complete sets, kits. Be sure to get this thrifty book before you buy. Write letter or postal NOW. Also include name of another fan.

LATEST HOOK-UPS

BARAWIK CO., 542B Monroe St., CHICAGO, U. S. A.

PATENTS

DON'T LOSE YOUR RIGHTS

Before disclosing your invention to anyone send for free blank form "EVIDENCE OF CONCEPTION" to be signed and witnessed.

LANCASTER & ALLWINE

Reg. Pat. Attys. in U. S. and Canada
270 Ouray Bldg., Washington, D. C.
Originators of the form "Evidence of Conception"

The secondary shunt variable condenser, as usual, should be the best obtainable and ought to be of the SLF type; a 7-plate serves well on the ranges down to about 60 meters; below this a 5-plate should be employed. Even with these comparatively small capacities tuning is often close; hence it is quite an advantage to have a good vernier attachment for best results.

Hand-capacity becomes especially noticeable at the higher frequencies; in this connection, it is often necessary to employ a 10-inch extension handle to overcome this effect, on a wavelength of 5 meters! The selection of properly-constructed condensers does away with this objection to some extent if the *rotary plates are connected to the filament side of the inductance* and not to the grid-end; this point is often overlooked.

ADJUSTMENT FOR LOWER WAVES

As the number of turns in the secondary inductance is reduced, the wavelength of the receiver is reduced and less turns are necessary in the fixed tickler for proper regeneration. Perhaps the best procedure in adjusting for the lower waves is a gradual reduction from some wavelength at which the operation of the receiver is understood. Choose a certain size of inductance that will allow tuning-in on this particular, familiar wave-band; and gradually reduce the number of turns in the secondary, say 5 or 6 turns at a time. For each reduction in the inductance it will be necessary to readjust the tickler coil, that is, to reduce its number of turns somewhat.

If the set will not regenerate on the lower settings of the secondary condenser, the number of turns in the tickler coil is too high or they may be too close. Usually,

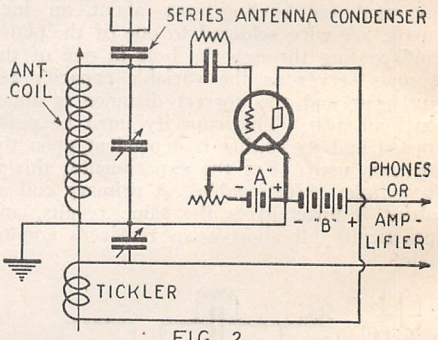


FIG. 2

A modification of the Schnell circuit wherein the primary inductance is eliminated through the use of a fixed series antenna condenser.

however, the number of turns determines the range of regeneration control and proper spacing improves matters by not allowing such violent regeneration or oscillations and promoting more critical control by the by-pass condenser. In general, the lower the wavelength, the less the turns necessary in the tickler and with a given tickler, the less the capacity necessary in this condenser. More turns may then be removed and the adjustments made again, until the desired wavelength is reached.

But take it easy. If you are not well acquainted with short-wave pecularities you may get lost, especially if a wavemeter is not available; but a rough check may be secured by listening for the amateur bands. A telegraph and telephone band exists around 80 meters, another at about 40 meters and yet another at 20 meters. Hence if one expects to operate his receiver at 65 meters, say, and can tune-in code and amateur phone with a certain value of inductance, etc., 65 meters is not very far below, and so on. Yet another method is to construct a receiver exactly to specifications given, for coil sizes and the like. This is usually objectionable, however, and sometimes difficult to do. With a little experimentation, the operation of determining one's wavelength is not difficult.

The oscillation control, in this case a

variable condenser, is perhaps the most important part of a short-wave receiver for maximum sensitivity and volume. If a cheap condenser must be used for this purpose, the best way to connect it so that hand-capacity effects are at a minimum is to connect the rotary plates to the "B" battery side, the stationary plates being connected to the tickler.

If full-scale setting of the by-pass condenser is necessary for any setting of the secondary dial, and it is not desired to change the coils because of good oscillation control on the rest of the range, a small R.F. choke-coil may be inserted between the tickler and this condenser; this will allow regeneration with less capacity. This, by the way, is a very satisfactory method of comparing R.F. choke-coils, that is, their effectiveness at this frequency; the better choke-coils require less throttling-condenser capacity to allow regeneration. A fairly large choke in this position will allow regeneration with very few tickler turns indeed.

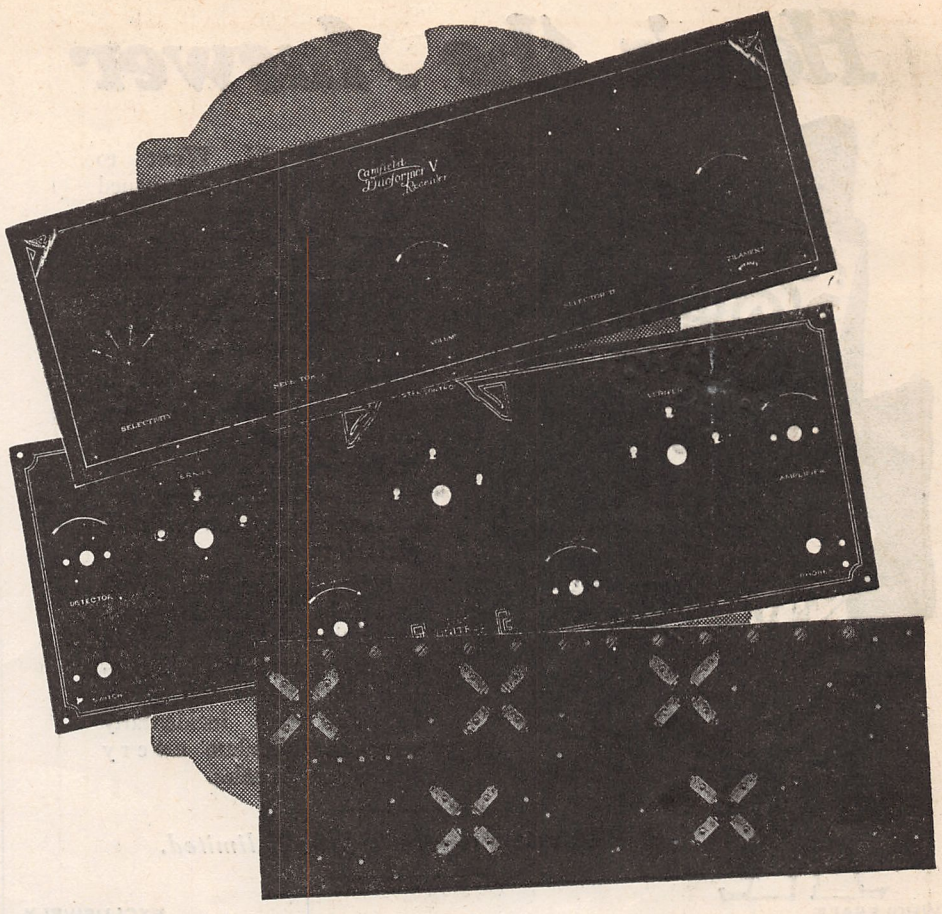
For a condenser to give good regeneration control on practically any wave-band, 10 or 12 plates will be necessary. Don't expect such a condenser to give good regeneration control over a wide wavelength range. At the lowest wavelength setting, a small change in wavelength sometimes requires a large change in this capacity, hence the position of the tickler, that is, its distance from the secondary, its number of turns, etc., should be properly adjusted at the wavelengths that are desired to be used, for best results, as described.

REGENERATION TROUBLES

A difficulty that most everyone encounters when first dealing with a circuit of this type is caused by a refusal of the set to regenerate; especially is this noticed after a new tickler coil is inserted or some change made in the oscillation control. "B" battery voltage causes the greater part of these difficulties; be sure that the "B" voltage is correct and ample. The correct filament current is also important for correct oscillation control; after the set is once working properly the filament is turned down as low as possible consistent with proper control. While still experimenting with various tickler coils and the like, it is best to have the filament a little high rather than too low, of course. The tickler coil causes the rest of the difficulties; it is usually either too small or its field is in the wrong direction for proper feed-back; the correct direction is the same no matter which way the secondary coil may be turned, end-for-end. The proper number of turns is determined by experiment.

In this connection, it may be well to wind several coils differing by a turn or two; these are not so important; wind the turns in a "bunch" on a piece of tubing somewhat smaller in diameter than the secondary coils, remove and tie together with string. When determining the correct value, insert the particular coil, couple it closely to the secondary and vary the condenser settings. In doing this, move the secondary condenser about one-fourth full-scale setting at a time and for each of the settings slowly move the oscillation control from minimum to maximum; "slowly" because regeneration is often feeble. Ordinarily no loud oscillations are noticed. If this does not bring results, reverse the tickler coil and repeat the operation. It is unnecessary to remove the coil from its support, just twist it round. If still there are no results, try a coil with a different number of turns; this procedure may be troublesome if repeated very often, hence a gradual changing is best as already suggested.

After the receiver is approximately on the correct wavelength that is expected to be used, it may be necessary to add to, or reduce the turns in the inductance slightly, so that



FORMICA PANELS

Sub-Panels and Tubes

YOU will find them again in most of the leading sets this year. The front panels are Veri Chromed in silver and gold and in several colors. They have a wide range of decoration from simple and dignified to elaborate and decorative.

Sub-Panels are offered complete with contacts and sockets attached, or with holes punched. Markings are stamped or Veri-Chromed as the purchaser prefers. This is the most complete service on insulation that is available.

VERI CHROMED PANELS FOR KITS

Formica Panels Veri Chromed in gold on high gloss black Formica are supplied to amateur set builders who put together the leading kits. We have in stock, panels for Bremer Tully Counterphase; Browning Drake National; General Radio Four Tube Universal; LC 26 Cockaday; Victoreen Superheterodyne; Best's Superheterodyne; Madison Moore Superheterodyne; Camfield Duoformer; Aerodyne 5 Tube; St. James 8 Tube and Karas Equamatic front and sub panel. Infradyne, 7 x 30 and 7 x 28.

Standard Formica panels are carried in stock by leading dealers—they can get special sizes for you

THE FORMICA INSULATION CO.

4618 Spring Grove Avenue Cincinnati, Ohio

FORMICA

Made from Anhydrous Bakelite Resins

SHEETS TUBES RODS

APPROVED RADIO NEWS LABORATORIES 1925

Here's the Answer

THE "I Want to Know" Booklet issued by Hommel is now ready for distribution to every radio dealer who wants to put his customers on a familiar footing with every-day radio problems.

It's the alpha and omega of useful radio information—the question and answer of many common radio queries—a booklet that every radio customer will be pleased to get.

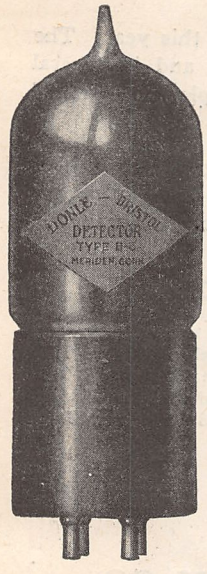
Every dealer will profit by their distribution, because these booklets contain not only interesting information that customers want, but also will incidentally serve to stimulate every dealer's radio sales.

Write to-day—the supply is limited.

WHOLESALE EXCLUSIVELY

LUDWIG HOMMEL & CO

929 PENN AVENUE PITTSBURGH, PA.



B-6 TUBE

$5

Announcing—

BECAUSE of the ready acceptance of the B-6 Tube and the circuit we have developed for it, and to comply with general request, we announce a kit in two forms and a complete set built to the specifications of this circuit. Send for literature.

THE DONLE - BRISTOL CORP.

MERIDEN - - CONNECTICUT

FREE RADIO GUIDE

164-PAGE (1927) GUIDE

Gives special hook-ups with illustrations. Shows big savings on standard radio parts, complete sets, kits. Be sure to get this thrifty book before you buy. Write letter or postal NOW. Also include name of another fan.

BARAWIK CO., 542B Monroe St., CHICAGO, U. S. A.

84 Illustrated Pages of Radio Bargains!

Write for Catalog Today

RANDOLPH RADIO CORP.

180 N. UNION AV. Dept. 2 CHICAGO, ILL.

tuning may be done at the correct position on the wavelength dial. A tickler coil should be selected of the correct value and properly spaced from the secondary so that the set may be made to regenerate at about the center of the by-pass condenser scale when it is properly tuned. Regeneration should not start with a click but quietly and with a gentle "hiss." Since a click is a sudden beginning of regeneration, it may be readily seen that the most sensitive spot of the whole receiver, just at the point of regeneration, is lost. This may usually be remedied by adjusting the distance of the fixed tickler from the secondary and sometimes by reducing the plate voltage. Close coupling of the antenna coil may also cause clicks or violent regeneration. Other causes are poor tubes, grid condensers and grid leaks, especially the variable ones.

Another very common difficulty is caused by very close coupling of the primary and secondary coils. This will not work on the short waves, usually. The usual high-resistance antenna closely coupled to the secondary prevents the tube from oscillating freely. Use enough coupling to allow the proper regeneration and selectivity.

TUBE SELECTION

The detector tube is of great importance if sensitivity, proper regeneration and a minimum of unnecessary noise, are desired. Some tubes regenerate with a hum, others with a click and still others with a gentle "hiss." The grid-leak may influence this to some extent; but in general only the third type of tube should be employed where quiet, sensitive reception is desired. A good tube with a socket that will not allow "ringing" (which is especially noticeable at the higher frequencies in sets subject to vibration) is certainly a big step toward proper receiver operation. Flexible leads, such as thin foil, near the socket terminals prevent vibrations reaching the tube through the wiring.

The grid-leak, besides being sometimes the cause of unnecessary noises, is often not of the proper value. A variable grid-leak for securing the proper grid resistance is an advantage, especially where a variety of different wavelengths may be used. It has been found that the grid-leak gives proper

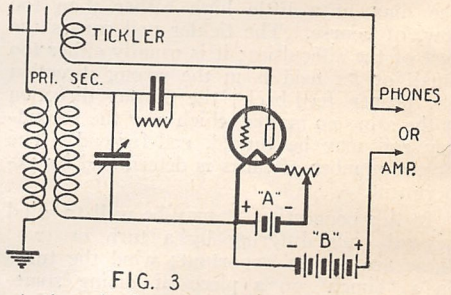


FIG. 3

A three-circuit tuner with a variable tickler coil, formerly employed for short-wave reception.

oscillation control under most circumstances. This is hardly noticeable on the higher wavelengths; but almost all short-wave circuits give better results if a proper value of resistance is employed. In general the proper resistance for short-wave receivers is higher; sometimes very much higher. The selection of the proper resistance is important where short-wave broadcast receiving is to be done. After the proper value for the particular wave-band is known, a fixed leak may be used.

For efficiency, of course, all parts should be as low-loss as possible and the wiring be well-spaced. It is difficult to conceive how any cramped, panel-mounted short-wave receiver can compete with one neatly laid-out, all parts given the proper spacing and the amplifier placed off by itself. Since those interested in short-wave receiving are most-

ly experimenters anyway, why not construct a real low-loss, bread-board set employing this circuit, which may be readily changed to receive on any wavelength by merely changing the inductances?

Since the oscillation control is quite independent of the rest of the adjustments, this circuit may be easily calibrated. There is a great tendency to look very closely at the graduations on the wavelength dial as if the stations were actually hidden there; hence it is advantageous to use a pointer and a large scale which may be accurately calibrated in wavelengths. This makes reception all the more interesting, the graduations are readily seen and the location of stations is facilitated.

All objects of any description should be kept away from the antenna, the coils, etc., for the increase in losses caused by such is high. All leads should be of fairly large wire, as short and as direct as possible; especially is this true of the secondary and plate circuits. Since a low-resistance circuit always tunes sharper it is not necessary to employ such loose coupling to the antenna circuit in congested areas where there may be considerable interference. Satisfactory regeneration below the oscillation point of the tube is very desirable; hence keep the circuit resistances low. A good soldering-copper is perhaps the worst enemy of such resistance.

With the movable tickler coil that was formerly in general use (See Fig. 3), it was quite an advantage to split the secondary into two sections, the tickler coil being coupled to that portion which was not coupled to the antenna and which was set at right angles to the other secondary coil; in this way any motion of the tickler did not necessitate a readjustment of the other controls. With this circuit, this may also be of some advantage but the tickler-coil is a fixed one anyway and the regeneration control is quite independent.

OPERATION OF THE RECEIVER

The filament rheostat is set at the proper value. The secondary condenser is slowly turned while keeping the other condenser at the point of regeneration. Don't think for a minute that one setting of the oscillation control will serve for the whole condenser range; this mistake is often made; signal strength may be increased by as much as 100%; signals that would be inaudible may be easily brought in by proper handling. It is evident therefore, that the nearer the point of regeneration the greater the signal strength; not a little better, but a *very great deal* better—another reason for not tolerating the click as previously described. This critical adjustment of the oscillation control for greatest sensitivity is probably the greatest difference between this circuit and the ordinary movable tickler-coil variety. The short wavelengths employed have also something to do with this. When a station is picked up, change to the secondary vernier and vary both condensers until maximum signal-strength, good quality and volume are obtained. The adjustment for telegraph, C. W. signals will not be as particular as adjustment for broadcasting. Little difficulty will be experienced with the latter if the oscillation control is set at the proper value and the vernier is used.

Many claim that their receivers work just as well with the dotted line in Fig. 1 connecting the primary and secondary omitted. One useful purpose of this is to reduce hand-capacity effects; but there are some disadvantages. With this lead connected as shown one hears a rather disagreeable hum when the set is not regenerating, and to some extent just at the point of regeneration. If the set were to be operated above this condition at all times this hum could not be heard; but when operating for maximum sensitivity this noise becomes monotonous

PROVED!

FORTY Thousand Tests on different sets have proved the satisfactory performance of the good Ferbend "B" Eliminator. 40,000 Ferbend "B" Eliminators are now in use. This wonderful instrument is in its second successful year of usefulness. Until you have used a Ferbend "B" Eliminator you have not known the ultimate in radio enjoyment.

The satisfaction of Ferbend owners is proved again and again—every day of every month—by the steady flow of hundreds of unsolicited testimonial letters from users of this very fine instrument. The few reproduced here are merely examples of what every mail brings from all sections of America. This flow of testimonials proves beyond a doubt the splendid performance, reliability, convenience and long-lasting qualities of the Ferbend "B" Eliminator. "No Hum"—"More Volume"—"Less Static"—"More Clarity"—"Complete Satisfaction." These reports from users are repeated again and again all through the testimonials. They prove the Ferbend "B" Eliminator is "over the top" to stay.

USERS ARE ENTHUSIASTIC

Fort Riley, Kans.
Am getting wonderful results with my Eliminator and good reports from those I have sold.
Floyd M. Farwell,
WIRE CHIEF, Sig. Det.

Ambridge, Pennsylvania
We are more than delighted with your Eliminator. Have had it since February and have had splendid results.
F L. McGRAW.

Petaluma, Calif.
I am highly pleased with your Eliminator. It will out-perform any "B" Eliminator on the market today. I have demonstrated it to friends owning Eliminators costing $50 to $75 and they all agree with me.
Ralph J. Rorden.

Dryden, Ont.
I am more than pleased with your "B" Eliminator and there is no doubt about it being better than any wet battery on the market.
D. M. Kentner.

Montreal, Quebec, Canada
I have sold all six of your "B" Eliminators and every one is pleased with it. It is one of the best on the market regardless of price.
Alfred A. Michand.

Yankton, So. Dak.
Our Eliminator has served its purpose wonderfully and we enjoy our radio very much since we received it.
Gust. Rundquist

New Orleans, La.
The "B" Eliminator I purchased from you some time ago is very satisfactory and I am much pleased with it.
W. M Kline,

Mt Morris, N. Y
The "B" Eliminator purchased months ago has given more than best results. Would not part with it for anything.
Frank J. Huver.

Amsterdam, N. Y.
The Eliminator is great. Have advised all my friends to get it for I know none could work any better or give more satisfaction.
Reg. Firth.

Brooklyn, N. Y.
I highly recommend your Eliminator to anyone regardless of the kind they expect to buy. Have had mine for over a year.
W. G. Stein

$12.50

COMPLETE
Nothing else to buy. Replaces "B" Batteries. Operates direct from Electric Light Socket on 110-120 volt A.C. lighting circuit. Delivers up to 100 volts.

FERBEND "B" ELIMINATOR

Within Reach of ALL

Second successful year—40,000 in use. Amazingly low in price—amazingly high in performance. An unequalled value in radio. Equal or superior to any "B" Eliminator regardless of price. We made this claim over a year ago. Today this statement still stands true—proved by overwhelming evidence.

NEW IMPROVEMENTS

developed and perfected by the Ferbend Electric Co., now give even greater lasting satisfaction to Ferbend users. New solution and new special alloy electrodes make possible a perfect electrolytic rectifier having longer life than any other type of rectifier.

FERBEND Wave Trap
This Company also manufactures the famous Ferbend WAVE TRAP—the instrument which has been widely imitated but never equalled. It is the only original and genuine. Priced at
$8.50

Ask Your Dealer—or Send Direct

If you prefer, we will make shipment direct to you upon receipt of price, or C. O. D., if desired. Use for 10 days to convince yourself—if unsatisfactory, write us within that time and purchase price will be refunded. Use coupon now.

THE FERBEND "B" ELIMINATOR is approved and passed by the rigid Laboratory Tests of Radio News, Popular Radio and Radio Broadcast.

FERBEND ELECTRIC CO., 425 W. Superior St., Chicago, Ill.

MAIL THIS COUPON TO-DAY!

FERBEND ELECTRIC CO., 425 W. Superior St., Chicago
☐ Send at once. Payment enclosed. ☐ Send C. O. D. ☐ Send Literature
Name.....
Address.....
City..... State.....

Variable High Resistance

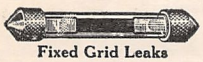
Single Pole Double Throw

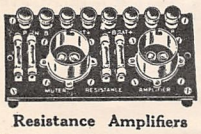
Double Pole Double Throw

Triple Pole Double Throw

Antenna Plug

Resistance Amplifier Unit


Fixed Grid Leaks


Resistance Amplifiers

MUTER

Dependable Products

make your set operate better

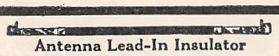
Endorsed and used by leading set builders

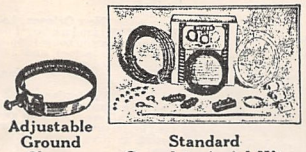
Quality at Popular Prices

May we send you our complete catalog? Write Dept. R.N.

LESLIE F. MUTER COMPANY
76th & Greenwood Avenue
CHICAGO, ILL.

MEMBER RMA


Antenna Lead-In Insulator

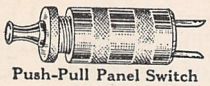

Standard Complete Aerial Kit

Adjustable Ground Clamp

Variable Condensers

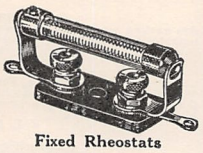
Interference and Static Eliminator

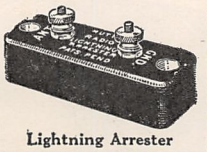
Audio Frequency Transformers


Push-Pull Panel Switch

Automatic Shock-Proof Phone Plug

Fixed Condensers


Fixed Rheostats


Lightning Arrester

YOU NEED THIS ACME RADIO CONTROL SWITCH

ENTIRELY AUTOMATIC IN ITS OPERATION

When the receiving set is turned on, the Trickle Charger is automatically disconnected from A Battery and B Power Unit is connected to set. When set is turned off, it automatically connects the Trickle Charger to the storage battery and starts the charge, disconnecting the B Eliminator from the set and line.

***The* ACME TRICKLE CHARGER**

An exceptionally fine economical product. Has a specially designed transformer with independent windings. Delivers ½ to ¾ amp. and consumes 25 to 40 watts. Attractive. Efficient. East of the Rockies..... $6
2 ampere bulb, $4

This switch may be used with any set regardless of type of charging equipment. Attractive in appearance. Guaranteed.

$5 complete, East of the Rockies

Acme Battery Charging Equipment is nationally known for its excellent performance.

Manufactured for 10 years by

THE ACME ELECTRIC AND MANUFACTURING COMPANY
1412 HAMILTON AVENUE - - - - CLEVELAND, OHIO

FREE RADIO GUIDE

LATEST HOOK-UPS

164-PAGE (1927) GUIDE
Gives special hook-ups with illustrations. Shows big savings on standard radio parts, complete sets kits. Be sure to get this thrifty book before you buy. Write letter or postal NOW. Also include name of another fan.
BARAWIK CO., 542B Monroe St., CHICAGO, U. S. A.

FREE

New Prmco Radio $42.50 list
5 days trial

FREE CATALOG — New Kind 5-Tube Radio. Coast-to-Coast on Horn — Direct from Factory — Dealers, Agents—Write for special offer today.

PORTS MFG. CO. Dept. R.N. FRESNO CALIF.

if head-phones are used for long periods. This is about the same proposition as listening with a headset to a receiver operated by an old-type "B" eliminator. Thus the slight advantage gained by the use of such a lead is more than offset.

It may be of interest to give some of the constants employed at a wavelength of 40 meters; this will give a general idea of what to expect and wavelengths above and below this may then easier be found with slight modifications:

Primary coil, 4 turns; secondary, 9 turns; tickler, 6 turns, all 2¾ inches in diameter;

7-megohm grid-leak;
5-plate tuning condenser;
10-plate regeneration condenser;
Cushioned sockets;
45 volts "B" (detector—one audio);
"Tested" detector tube—201-A type.

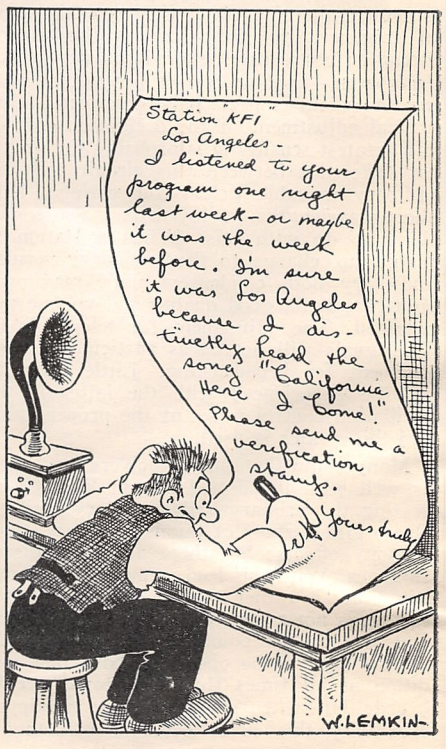
The only change necessary to receive from 10 to about 125 meters, that is, over a limited band anywhere within these limits, would be a change in the size of the inductances.

Closer coupling of the antenna coil to the secondary necessitates a large increase in the by-pass capacity; oscillations are more troublesome but they cease when the antenna switch, as used by amateurs, is thrown. A loud hum in the receivers usually means that the secondary is disconnected.

When the "ground-lead" is connected the wavelength of the receiver increases slightly. Do not run this lead, if used at any time, to the grid-end of the secondary by mistake; little or nothing may be heard in this case. Small pieces of cardboard inserted between the coils will keep them in their proper places and prevent objectionable vibrations.

Much has been said about the importance of good antennae; hence a few words will suffice. Whenever possible a long antenna, part of which is horizontal, should be used; since it has been found that short radio-waves coming from a distance are *polarized*, that is, the vibrations in the wave-front are more or less confined to a plane; naturally more energy is induced in the antenna if it is in the plane of these vibrations.

A RADIOPTIMIST



Speaking Over the Radio

(*Continued from page* 636)

permitting the concentration on speakers, which a lecture hall or theatre allows." Yet, speaking can be made so exciting that you can't leave.

OUR SATURDAY MORNING SYMPOSIUMS

If you will permit me, I am going to devote myself principally, this month, to these fascinating hours—every Saturday morning, beginning at eleven.

For certain reasons, they are important.

The time—the morning—is the period when people are supposed not to be eager to hear the radio because it is the time when only women and children are supposed to be able to get at a radio—because speaking is not supposed to "get under the skin," as they say in popular parlance—because speeches are supposed not to bring mail.

I'll take the last part of the paragraph first. Our mail on the Saturday morning symposiums is large; but more than that it is enlightening. People are thinking, and the radio is helping to make them think, better, more clearly. Men are writing—*more men than women*! So folks must be listening.

This is how we manage the symposiums.

Every week we invite five or six men and women prominent in varying fields; and each person talks, for only five to eight minutes, about his or her work. Right to the point you see. I act as chairman and I keep the contrasts going.

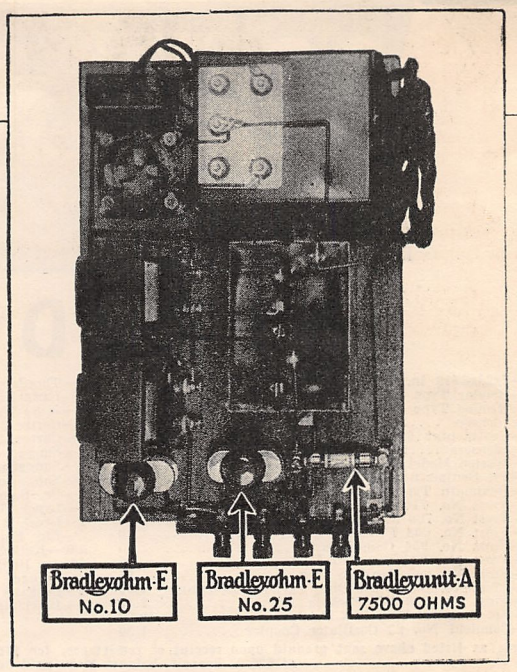
For instance, last week, this was the line-up: Reba Swain, prominent lawyer, charming woman, deputy attorney general of New York state, opened up—telling about the work she does with labor. Then came Bide Dudley, humorist and dramatic critic of the New York *Evening World*, who dryly told of his fictitious candidacy for the Presidency of the United States, his campaign slogan being "Send Dudley to the Chair," and whose campaign so attracted Mr. Coolidge, that the President sent for Will Rogers, who is campaigning for Bide, and who is supplied by the latter with ample chewing gum.

After Bide's laughable speech, came Leo Freedman of the Press Department of the Shubert theatre offices, telling why so many people try to put on plays, and how Miss Nichols made over a million out of "Abie's Irish Rose." And he was followed by Gerva Baronte, an Englishwoman from India, author of "The Eyes of India," who spoke of her dear friend, Rabindranath Tagore, greatest poet and teacher of the East, of his teachings and methods. Marie Keller, who heads the Federated Girls' Clubs, let the listeners into the secrets of club life. And finally Merryl Ruckeyser told intimate bits about Wall Street and stock brokerage. It was a complete and fascinating and kaleidoscopic set up.

AN INFORMAL FORUM

But that was just the beginning. Forty minutes had flown away. Then, as is our custom Saturday morning, I popped a question nobody had previously heard; and while Ralph Christman, of our studio staff, played a musical interlude, the speakers put on their thinking caps and answered the question. You can imagine, can't you—what they said?

This was the question: "Assume a woman married to a man who has no sense of his wife's need for individuality; assume her suddenly awakened to her status as house-worker-slave, and then falling in love for the first time in her life, with a man who arouses her to do great and worthy things—assume her asking for release from her husband—after due consideration—and the



A-B Allen-Bradley

What a whale of a difference a few Bradleyohms make —in a B-Eliminator!

Bradleyohm-E

For B-eliminator service requiring wide voltage control, Bradleyohm-E is essential. It is an oversize Bradleyohm with sufficient capacity to handle all normal B-eliminator requirements. Be sure to ask for Bradleyohm-E in the checkered carton. Your dealer can get them for you.

Bradleyunit-A

This solid, molded, fixed resistor has no glass or hermetic sealing in its construction. It is a solid unit with silver-plated end caps that are not affected by temperature, moisture and age. By all means, use Bradleyunit-A when you need a fixed resistor.

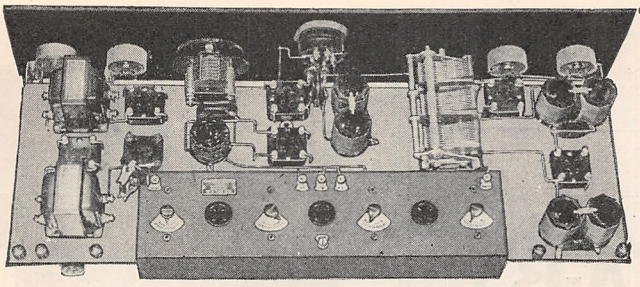
MAGAZINES and newspapers have been publishing circuits and instructions for assembling B-eliminators. Many types of kits have been used, but the outstanding feature has been the almost unanimous recommendation to use Bradleyohm-E for plate voltage control and Bradleyunit-A for the fixed resistor.

The leading manufacturers of B-eliminators have long since adopted Allen-Bradley variable and fixed resistors as standard equipment for their B-eliminators. In fact, the Bradleyohm-E has become almost as universally used in Raytheon tube B-eliminators as the Raytheon tube itself. The scientifically-treated graphite discs in these remarkable units have never been equaled for silent, stepless plate voltage control so essential for the satisfactory operation of a radio set with a B-eliminator.

When you build your B-eliminator, always insist that Bradleyohm-E and Bradleyunit-A are included with kit. You then will be assured of perfect voltage control. Send for folder "How to Build a B-eliminator" describing seven popular hookups.

ALLEN-BRADLEY CO.
287 Greenfield Ave. :: Milwaukee, Wis.

Use Allen-Bradley Perfect Radio Devices



INFRADYNE

1—7x28x3/16 in. Formica Panel (Engraved)	$ 6.85	2—Thordarson Type R200 Audio Transformers	16.00
1—Remler Type 700 Infradyne Amplifier	25.00	2—Kurz-Kasch Aristocrat Vernier Dials	4.00
1—Remler Type 630 .00035 Mfd. Variable Condenser	5.00	1—Jones Type BM Multiplug	4.50
1—Continental .00035 Mfd. 3 Gang Vernier Condensers	9.50	1—Carter 2 Ohm Fixed Resistance	.15
1—Weston Model 506, Type 217 0-7-140 Voltmeter	9.00	3—Carter 4 Ohm Fixed Resistances	.45
1—Pr. Benjamin Type 8629 Shelf Brackets	.70	2—Sangamo Mfd. By-Pass Condensers	2.50
1—Benjamin Type 9040 UX Cushion Sockct	.75	2—Sangamo .00025 Mfd. Fixed Condensers	.80
1—Frost No. 710 10 Ohm Rheostat	.50	1—Sangamo .0005 Mfd. Fixed Condenser	.40
2—Frost No. 730 30 Ohm Rheostats	1.00	1—Pr. Sangamo Grid Leak Clips	.10
1—Frost No. 608 Filament Switch	.30	1—Lynch Grid Leak Mounting	.35
1—Frost No. 954 Gem-Jack	.45	1—Lynch 2 Megohm Grid Leak	.50
1—Frost No. 234 Pan-Tab Jack	.75	5—Eby Engraved Binding Posts	.75
1—Frost No. 235 Pan-Tab Jack	.85	100—Kellogg Tinned Soldering Lugs	.75
1—Frost No. 88050,000 Ohm Variable Resistance	1.50	50 ft. Belden Tinned Copper Hookup Wire (12 gauge)	.50
6—Frost No. 530 UX Sockets	2.40	1—Package Kester Solder	.25
1—Set Camfield Type 22K Duoformers	10.00	1—Blackburn Ground Clamp	.25
1—Camfield No. 23 Oscillator Coupler	1.50		$108.30

Parts as listed above sent prepaid upon receipt of remittance, for $108.30, or will be sent C.O.D. upon receipt of $25.00 deposit, balance to be paid upon arrival.

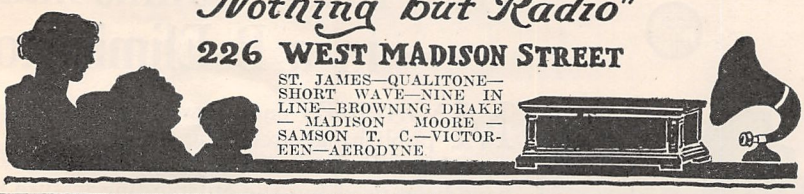
Dealers writing us specify just what hookup you are especially interested in.

NEWARK ELECTRIC CO.

"Nothing but Radio"

226 WEST MADISON STREET

ST. JAMES—QUALITONE—SHORT WAVE—NINE IN LINE—BROWNING DRAKE—MADISON MOORE—SAMSON T. C.—VICTOREEN—AERODYNE

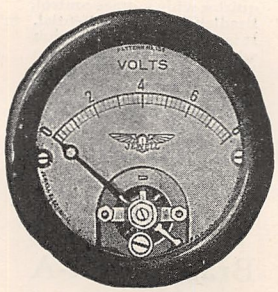


JEWELL

Infradyne Builders

here is the radio instrument recommended for use with the new Infradyne receiver. It is obtainable in any of the following ranges of which the **O-5 VOLT** has been particularly specified for the Infradyne:

0-5, 0-8 or 0-10 volts.....$7.00
0-10, 15, 25, 50 or 100 milliamperes.....$7.00



Pattern No. 135
Panel Mounting Voltmeter.
It is a quality instrument.

Send for new Radio Instrument Catalog No. 15-C

Jewell Electrical Instrument Co.

1650 Walnut Street - - Chicago

"26 YEARS MAKING GOOD INSTRUMENTS"

FREE RADIO GUIDE

164-PAGE (1927) GUIDE

LATEST HOOK-UPS

Gives special hook-ups with illustrations. Shows big savings on standard radio parts, complete sets, kits. Be sure to get this thrifty book before you buy. Write letter or postal NOW. Also include name of another fan.

BARAWIK CO., 542B Monroe St., CHICAGO, U. S. A.

COIL WINDINGS

Audio-B Eliminator—Bell Ringing Trans.

TELEPHONE RINGER—CHOKE—IGNITION—CONTROLLER & SPECIAL SOLENOID WINDINGS

Easton Coil Co. P. O. Box 237 Easton, Pa.

husband refusing to let her go—what should she do?"

Miss Keller said, "stay and readjust herself;" Miss Swain, explaining that no legal reasons were available for divorce, counselled waiting; Miss Baronte said, "It is all the same, whichever man." Bide Dudley was humorous, Mr. Ruckeyser spoke of financial and material considerations; Mr. Freedman started making a play out of it—and I, the chairman, spoke of the emotional and human elements concerned in it.

The whole program—only one hour and five minutes!

A MYRIAD VIEWPOINTS

Amongst those who have appeared and spoken were George Furness, who directs the Eveready Hour—he told of a fisherman he knew. Col. Wolcott Le Clear Beard, who was one of the first Americans to supervise the Philippines, spoke of his first execution! Irene Kuhn, American newspaper woman, told of the mysterious things she leaned in China—of the sing-song girl, of the Forbidden City of the Emperor, and so on. Maurice Livingston spoke about Paris. Rose Rothenberg, assistant district attorney of New York, told about the psychology of the prosecutor in a case. Herbert Mayer, who was responsible for the reopening of the Hall-Mills Case, told of his exciting adventures; Miss Ruth Leigh, about money making; Bert Berger, about ladies' clothing secrets; Creté Hutchinson about living in the wilderness; and so on through a long, long list.

Such speaking is so fascinating that, every Saturday morning, Roosevelt Hotel bellboys, elevator boys, maids, and others find excuses to bring them to the studio, if only for a few minutes.

Such speaking is good because it is brief, carefully figured out in advance, told by interesting people who are bristling with their ideas and work, and who are presented in an entertainment man's showmanlike method of programing.

I'd like to hear what our readers and listeners have to say about speaking over the radio.

DIGEST OF THE MONTH

What did we do at WRNY during the month of September, which has just ended as I write this article? I'll tell you the high lights.

Carl Schlegel, of the Metropolitan Opera House was a star of the Edison Hour, as was August Werner, the Scandinavian artist, and Arpad Babos, the Hungarian cymbalom player.

One night the cast of "My Country" were at WRNY—the Italian comedian, Joseph Verdi; the Jewish comedian, Lee Kolmar; the Irish comedian, Eddie O'Connor, and many others. Can you imagine the fun when they all started in dialect, to tell about their troubles—in that funny street of their play?

There was the time we were transported to the Philippines. A group of natives, headed by Jose Mossegeld Santiago, presented the music. Santiago is the leading musician of the Philippines and he showed himself an ample program maker, too. Languorous, unforgettable music it was—and it carried us thousands of miles across the Pacific.

Alfred McCann has been having lots of fun. The famous food expert told about "Trudy and Her Pork Chops"—Trudy being the Channel swimmer, which reminds me that Mrs. Corson, the first mother, you know, to swim the English Channel, was scooped by WRNY—and she spoke through our microphone.

The New York School of Arts and Music has started a series of programs for WRNY. Madame Parker is back with us, and Giuseppe Adami is back from Italy. "The Crooning Violinist" was with Musso-

lini on the other side, engaged Mascagni to come to America (later Mascagni broke his contract, or something else happened). Adami also obtained permission from the leading living Italian composers to play their new music in America over the WRNY microphone and he's already doing it.

I think I told you, a couple of months ago, about our birthday party. We have had another gala night—the grand fall opening. Now there was an idea! There were celebrities galore: Charles Hanson Towne, Harvey Ferguson, who has written a marvelous novel, "Hot Saturday"; Commander Ellsberg, who raised the S-51; Victor Rosewater; and all sorts of musical and dramatic treats.

AT THE BIG SHOW

Yes, we were in the World's Radio Fair. We had the only special and exclusive broadcast studio at Madison Square Garden. We had programs there every day, and you should have seen the mobs! We also joined our sister stations in the big crystal studio—the official studio of the show. We were hosts on the second afternoon and the closing nights of the Exposition. The Edison Hour came over in force, and there were other novelties. Caroline Lee, the radio girl of the South, and her Clearwater (Florida) announcer were given exclusively to us, and we were glad to have them. Mrs. Harrauff spoke on WRNY's time, and so on.

WAKING UP THE VOTERS

Now that we are near election, of course WRNY is going after it, good and plenty.

But WRNY is non-partisan. We refuse to take sides, and unlike some others, we are not trying to sell time to political speakers. Our rule is that we want the people to hear the big men and women on all sides; and, because we take that stand, we are bringing only the really great. WRNY, for instance, was chosen first to broadcast the notification to Ogden Mills and Senator Wadsworth—the Republican candidates for Governor of New York and United States Senator. Congressman Tillson, Mrs. Franklin D. Roosevelt, Elizabeth Marbury, Attorney-General Ottinger—I could read you a long list of our distinguished speakers.

But I want to take a minute to write about something which is worthy the space of this entire article, the Israel Zangwill Memorial. There have been those, whose criticisms I prize, who said it was the outstanding event in all radio for a month. Dr. Stephen S. Wise, Dr. Nathan Krass, Dr. Isaac Landman, three great rabbis; Wilton Lackaye and Loney Haskell, actors; Harry Hansen, literary critic; David Freedman, author of Eddie Cantor's new play, "Mendel Marantz," and many others thrilled the listeners with eloquence and music.

MANY THINGS GRAVE AND GAY

In contrast to the solemnity of that memorial was Jack Blue's dance festival, with dance steps tickling through the microphone, or the "Tower of Babel"—it came on Novelty Night. It looked and sounded like Locarno. The Consuls-General of France and Czechoslovakia were present and spoke in their own languages; representatives of leading German and Spanish papers followed suit; and artists of these countries presented their native music in native tongue. Even Wales and Japan were represented, and of course Russia, Italy and America were not to be overlooked. (I shall never forget the group, and the sound of their conversations—the little cliques, the wonderful sense of the world in miniature—and Babel restored).

MORE UP TO DATE

The old expression "Hire a Hall" has given place to a more modern one "Broadcast it!"—*D. F. Kirby.*

Leadership

with Benjamin Radio Products in Securing the Best Radio Results

All Benjamin Radio Products are of the same high standard as the far-famed Cle-Ra-Tone Sockets

You will find that almost every good radio set in the neighborhood has some or all Benjamin Radio Products in it. Radio experts and set makers have proved through long experience that only radio parts conscientiously and painfully made to improve delicate tonal quality, selectivity and volume can bring a leadership in securing the best radio results.

If you would have your set just as good or better than your neighbor's make sure that every component part is reliable and bears the trade mark of a manufacturer in whom you can place your full confidence. The world-wide recommendation of Benjamin Radio Products by radio authorities is the best testimonial for their scientific accuracy and uniformity in securing the best radio results.

Rewards for Radio Reasoners

Awards for novel and original hook-ups, modifications of existing circuits; trade names; slogans; write our nearest office for full details.

If your dealer cannot furnish you with Benjamin Radio Products send amount direct to our nearest sales office with his name and we will see that you are promptly supplied.

Benjamin Electric Mfg. Co.
120-128 S. Sangamon St.
Chicago

New York: 247 W. 17th St.
San Francisco: 448 Bryant St.

Manufactured in Canada by the Benjamin Electric Mfg. Co. of Canada, Ltd., Toronto, Ontario

Improved Tuned Radio Frequency Transformers

Space wound; basket weave; cylindrical; highest practical air dielectric. Proved to give the best results in sharpness of tuning, increase in volume and improvement in quality. Authoritative laboratory tests and practical experience of manufacturers and amateurs shows that this type of coil excels in every important characteristic.

2¼-inch Diameter Transformer

Compact. Especially desirable for crowded assembly. Eliminates interfering "pick-ups."

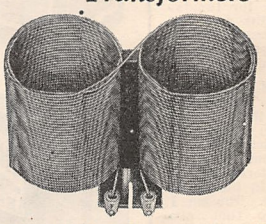
Set of Three, $5.75
Single Transformer, $2.10

3-inch Diameter Transformer

Capacity coupling reduced to lowest degree. For use with .00035 Mfd. Condensers.

Set of Three, $6.00
Single Transformer, $2.25

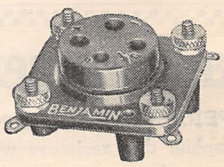
"Lekeless" Transformers



Uniform high inductance, low distributed capacity and low resistance. The external field is so slight that it permits placing coils close together without appreciable interaction.

Single Transformer, $2.50

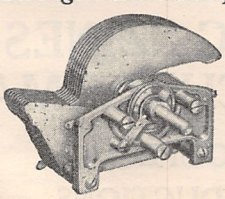
Cle-Ra-Tone Spring Supported—Shock-Absorbing Sockets



Spring Supported, Shock-Absorbing, Stop Tube Noises. The greatest aid to non-noisy operation. Contacts always clean.

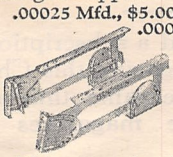
75 cents each

Straight Line Frequency Condensers



Eliminates bunching of stations. Spreads the log evenly over the dial. Makes tuning easy. Adjustable turning tension. Compact. A beautiful instrument that not only improves reception, but adds to the good appearance of the set.

.00025 Mfd., $5.00 **.00035 Mfd., $5.25**
.0005 Mfd., $5.50



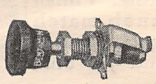
Brackets

An aid to simplification in set construction. Supports the sub-panel, with room underneath for accessories and wiring.

Plain—70c pair. Adjustable—$1.25 pair

Battery Switch

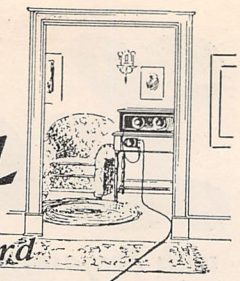
Quick, positive, clean-cut make and break. When it's "in" it's "off", eliminating danger of wasteful use of battery.

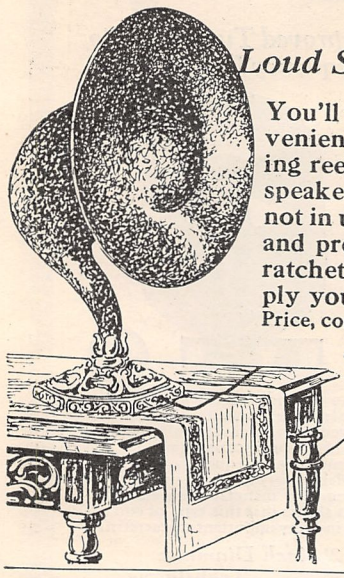


30 cents each

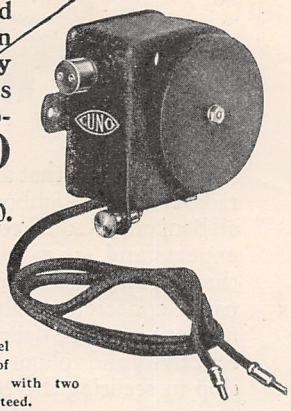
New! RADIO CUNO REEL

Loud Speaker Extension Cord





You'll want one of these real conveniences. With the self-rewinding reel, you can place your loud speaker where you want it; when not in use, keeps cord out of way and protects it. Button controls ratchet. If your dealer can't supply you, order direct.
Price, complete, postpaid . . **$3.50**



The Cuno Engineering Corp.
80 South Vine St.
Meriden
Conn.

Handsomely finished in brown enamel and nickel, complete with 25 feet of high grade cord. Easy to attach with two screws. Well made and fully guaranteed.

BUY BATTERY CAPACITY

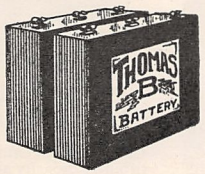
Thomas Battery Combination

BUY BATTERY CAPACITY

JACK SAGINARIO
Bronx, N. Y. City
I am very glad I was recommended to your battery as I get twice the volume. I will always recommend it to my friends.

JULIUS R. BROWN
New York City
I have used Thomas Batteries for twenty-two months and will always recommend it to the next person as being the "goods."

HIRAM MORGAN
Beloit, Wisconsin
I guess the best appreciation I can show is to enclose check for one of your 100 Amp. hour batteries as advertised in the Radio Magazine. The one I got some time ago from you is Perfect and giving excellent continuous service.



THIS "A" BATTERY

100 Amp. hour "A" Battery, standard rate. 6-Volt capacity absolutely guaranteed—will operate Average 5 tube set for a month or more on a single charge. Solid rubber compartment case, lead coated handle. Non-corrosive terminals.

GUARANTEED 2 YEARS
OVER 18,000 SATISFIED CUSTOMERS

AND THESE "B" BATTERIES

Standard, high power, maximum service, 45-Volt. "B" batteries. Seamless cells. Built of best "B" battery materials. None better at any price.

ALL FOR $13.98

Shipped direct from the factory—promptly, No delays—Every battery fresh. NO ADVANCE PAYMENT REQUIRED. Simply order—and we will ship by express and you examine batteries at express office to your heart's content—pay the expressman $13.98 plus express charges if you decide to take them.
If you prefer to remit with order—deduct 50 cents.
These "A" and "B" batteries can be purchased separately. "A" Battery (Same as above) $10.50. "B" Battery (Same as above) $2.50 each.

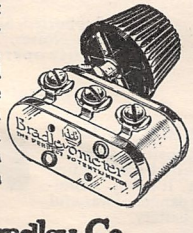
All prices for Domestic Shipments only—Export price 15 percent additional. Prices other sizes and auto batteries on request.

THOMAS BATTERY CORP.,
507 West 50th St., N. Y. City
Gentlemen: I am enclosing $.....for ( ) "A" Batteries ( ) "B" Batteries as advertised in RADIO NEWS.
NAME .....
ADDRESS .....
CITY..... STATE.....

Bradleyometer

THE PERFECT POTENTIOMETER

Uses graphite disc resistors which are noiseless and not affected by atmospheric conditions. Metal parts are nickel plated. One hole mounting. Finish and knob match Bradleystat. Made in 200 and 400 ohm ratings.



Allen-Bradley Co.
Electric Controlling Apparatus
287 Greenfield Avenue Milwaukee, Wis.

MAGAZINES FOR CHRISTMAS

BIG SPECIAL REDUCTIONS

Give your friend a subscription to his favorite Magazine this Christmas and at the same time save money on the magazines you want.

SEE PAGE 772
IN THIS ISSUE

Loud Speakers

(*Continued from page* 645)

tro-mechanical driving unit and a cone. The driving unit is composed of an electro-magnet, a balanced vibrating reed, and a rod or lever. The lever is fastened directly to the center of the flexible cone. The action is somewhat like that of a piston, the surface of the cone being pushed and pulled by the movement of the lever. The motion of the cone in turn displaces the mass of air within the limits of its surface, causing first a "condensation" and then a "rarefaction"—or, stated more simply, causing variations in air pressure.

It is important to consider the fact that, *when a pressure is created at the front of the cone, "rarefaction" is taking place at the rear,* and vice versa. Thus, there is a difference in pressure on the two sides, and the air rushes around from one to the other. In some cases this has a marked effect on the reproduction, either decreasing the volume of the bass notes or introducing stray harmonics. This action is practically eliminated by the use of some form of "baffle," which may take the form of a large wooden circle (see Fig. 7), but in the case of the cone illustrated, it is formed by the rear flexible support, *i.e.,* that part of the cone turned back on itself.

RANGE OF FREQUENCIES IN THE CONE

The average cone speaker has somewhat better frequency-characteristics than the usual horn speaker, due principally to the resonant qualities inherent in the shape of the cone itself. Nevertheless, the diameter of the cone is a factor in the reproduction of low frequencies, as is the length in the case of a horn.

The cone may be considered as a vibrating diaphragm having numerous resonant points along its surface. All vibrations leave the center and travel out along the surface of the cone. The central portion of the cone is resonant to the high frequencies, which do not travel very far due to rapid damping. Low frequencies, however, find resonant points further out; the extremely low notes at the periphery of the cone. All the frequencies suffer some attenuation, due to transmission losses; the extent of the attenuation for any given frequency is dependent on the degree of rigidity of the material constituting the cone. Most of the loss is usually at the higher frequencies, since the cones are made somewhat rigid in order to handle the bass notes. This will show up in the frequency-characteristics of the cone and may be advantageous if not overdone.

The cone speaker shown in Fig. 5 is also of the enclosed or fixed-edge type and has a diameter of three feet. It is capable of reproducing faithfully all the musical frequencies which can be broadcast effectively. It is highly improbable that the flexible support at the rear ever does more than make the sound distribution curve of the speaker more favorable, at least it is unnecessary that it function as a baffle; for a speaker with a cone or diaphragm of such large diameter does not suffer from the ill effects of the tendency towards "pressure equalization" formerly mentioned.

"FREE-EDGE" CONES

The free-edge cone speaker differs but slightly from the fixed-edge type. It may, in some cases, show some advantage over the fixed-edge type for the reason that the resonance characteristics are those of the cone only; the cone is entirely independent of all other parts of the speaker. A few typical free-edge cone speakers are shown in Fig. 6. These are sometimes referred to as "floating cones," for the only point of contact is at the center where the actuating lever is attached.

Another type of free-edge cone is shown in Figs. 7 and 8. The cone or diaphragm is made very small and light of weight; the diameter is usually not more than 6 or 8 inches. The effective surface, however, is fairly large, due to the great depth of the cone.

These cones are designed to resonate at some low frequency, say 40 to 60 cycles, and, being of small diameter, are used in conjunction with a baffle. The speaker shown in Fig. 7 has a baffle in the form of a wooden ring, which also acts somewhat as a sounding board; while the baffle in the speaker shown in Fig. 8 is formed by the cabinet which encloses the cone and its driving unit.

Though these small free-edge cones show evidence of "flexural" vibration, particularly on low power, they can be considered as being practically non-resonant on high power, when the piston action predominates.

The power speaker shown in Fig. 9 has a small cone, about 6 inches in diameter, with its edge attached to a thin leather supporting ring. It can be classified as of the free-edge type, as the ring introduces no limiting factors.

Though it has been said that a cone with a large diameter will reproduce bass notes more readily than a cone of small diameter, it should be understood that the small concave free-edge cones can accomplish the same thing, as they do not limit the action of the driving unit to which they are attached.

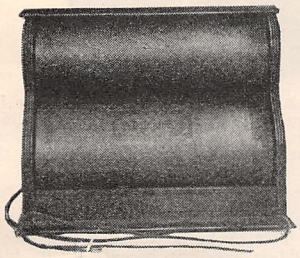


Fig. 11. A roll-type speaker, actuated by a drive unit attached to the central meeting point of two flexible rolls in the shape of half-cylinders. In operation the cylinders are given a rolling motion.

Photo courtesy of Dictograph Products Corp.

The cone speaker shown in Fig. 10 is of the "eccentric" type, with the drive-rod or lever attached to the cone *off center*. The distances from the "working center" to the rim being unequal, many resonance points are eliminated and the creation of undesirable harmonics is prevented. The long sections caused by the unequal division reproduce the low-register notes, and the short sections the high-register notes.

Another type of diaphragm speaker of unique design is shown in Fig. 11. It is known as the "roll" type, and is formed by a single sheet of special paper or "fonotex" folded off-center and rolled to make two half-cylinders of unequal width. The drive unit is fastened to the fold, so that any motion of the drive unit lever gives the two cylinders a rolling motion. The air mass is "swished" instead of pushed; yet the air is displaced in a normal manner. (The action is similar to the "flexural" motion of a cone). The large cylinder reproduces the low notes, the small cylinder the higher ones.

RELATIVE MERITS

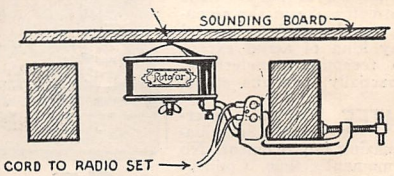
We can learn, from the foregoing descriptions of horn and diaphragm loud-speakers, that the main differences rest in design only; that the fundamental principles are very much the same, as are the results. It has been pointed out that a horn speaker, if properly designed, can equal a given type of cone speaker insofar as the reproduction of a very broad band of musical frequencies is concerned; but a small cone speaker will

Perfect Reproduction of every Note in the Musical Scale

HEAR your piano talk! Listen to the clearest, most mellow radio music anyone has ever heard. Harsh, "tinny" tones are entirely eliminated by a revolutionary new principle which enables this "Invisible Speaker" to faithfully reproduce **every** note broadcasted. Absolutely **unlimited** tone range.

NO MORE UGLY HORNS

The world's finest musical instrument — your piano — becomes the "horn" of the **Rotofor** Speaker. The huge wooden piano sounding board **diffuses** the notes properly, whereas, the narrow neck of a horn cramps and distorts them.

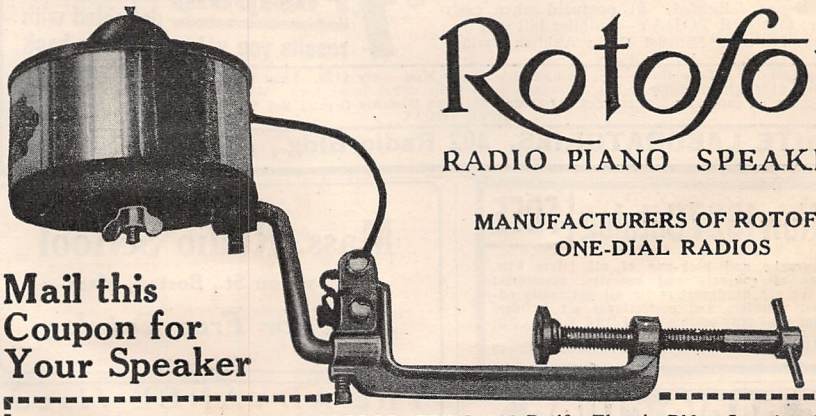


CAN'T HARM YOUR PIANO

Use of the **Rotofor** Radio Piano Speaker doesn't injure or interfere with your piano in any way. The Rotofor is instantly clamped out of sight,—and a hidden wire, as long as desired, connects with the loud speaker socket of your radio.

FREE TRIAL IN YOUR HOME

Hear and compare the remarkable **Rotofor** in your own house. Listen while it brings in low and high notes you've never heard before. Sold under a money-back guarantee of satisfaction. If your dealer can't supply you, mail the coupon.



Rotofor

RADIO PIANO SPEAKER

MANUFACTURERS OF ROTOFOR ONE-DIAL RADIOS

Mail this Coupon for Your Speaker

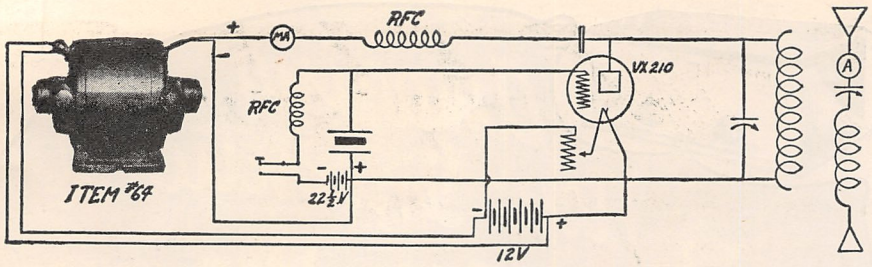
INTERNATIONAL RADIO CORPORATION, 145 Pacific Electric Bldg., Los Angeles, Calif. or 225 W. Ohio Street, Chicago, Illinois.

( ) I enclose $28.00. Send me a Rotofor Piano Speaker prepaid.
( ) Send a Rotofor Piano Speaker C.O.D. for 10 days' trial—money back if I'm dissatisfied.
( ) Send a Rotofor Piano Speaker to my dealer to deliver to me.
( ) Send me more information about the Rotofor Piano Speaker.
( ) Send me information about Rotofor—"The Radio Simplified"—one dial—5 tubes.

Name..... Address.....

City..... State.....

Dealer's Name ..... Address .....



THIS is the first of a series of five "hook-ups" for crystal control transmitters using "ESCO" Maximum miles per watt Power Supply.

The above diagram shows one of the simplest workable controlled transmitters. The key is in the grid bias circuit. The set is operated from a 12 volt storage battery, filament supply being obtained directly from the battery, and plate supply from Item 64 operating from the 12 volt battery. The crystal is to have a fundamental in the 80 meter band for 80, 40 or 20 meter operation.

ELECTRIC SPECIALTY COMPANY

TRADE "ESCO" MARK

211 South Street Stamford, Conn., U.S.A.

Manufacturers of Motors, Generators, Motor - Generators, Dynamotors and Rotary Converters for Radio and other purposes

Fred W. Stein.

Steinite Greatest $1 Value in Radio Today

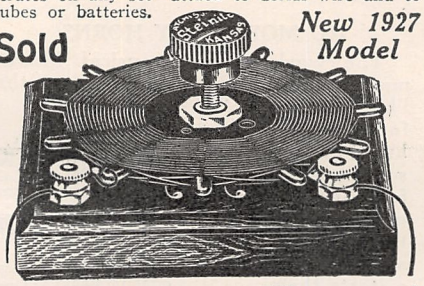
INTERFERENCE ELIMINATOR

NO RADIO SET COMPLETE WITHOUT IT

Select stations at will. Especially necessary for 1 and 2 dial controlled sets. Under present conditions the average set fails to bring in the desired stations properly. The Steinite Interference Eliminator shuts out local and other interference. You get one station at a time, the one you want, and tune in loud and clear. Operates on any set—attach to aerial wire and to set—no changes—no extra tubes or batteries.

Over 400,000 Sold

New 1927 Model



Improved Results with Tube or Crystal

Try entirely at my risk the wonderful improvement this inexpensive little device will make in the reception of your set. Improves results on both crystal and tube sets that use any kind of aerial except loop antenna. Clears up reception wonderfully, increases volume and partially absorbs static. Money-Back Guarantee.

MONEY BACK GUARANTEE Put this interference eliminator on your set and note amazing improvement. No tools needed—install in a moment's time. Connect with set and follow simple instructions. Money back promptly if not delighted. $1 postpaid when cash with order. ORDER TODAY—a dollar bill will do.

References: Exchange National Bank; Atchison Savings Bank.

$1 Postpaid If you are not delighted with results you get your dollar back

The New Steinite 7-Tube Radio uses no batteries of any kind—only $125. Loud Speaker Built in. Complete with tubes $151 with nothing to buy. Operates from light socket 1c an hour. Write for descriptive literature before buying an expensive Battery Set. Also Steinite Long Distance Crystal Set $6—6-Tube Battery Set $45. WRITE TODAY.

STEINITE LABORATORIES, 402 Radio Bldg., Atchison, Kansas

FREE | New 1927 Catalog | FREE

Shows photographs and hook-ups of all latest kits, complete line of cabinets and consoles, accessories and parts. We are headquarters for all nationally advertised lines. Dealers and professional set builders write today for your copy of this big FREE CATALOG.

SHURE RADIO CO., 7—19 S. Wells St., Chicago

Mass. Radio School

18 Boylston St., Boston, Mass.

Send for Free Catalog

FREE RADIO GUIDE

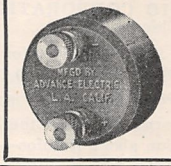
LATEST HOOK-UPS

164-PAGE (1927) GUIDE

Gives special hook-ups with illustrations. Shows big savings on standard radio parts, complete sets, kits. Be sure to get this thrifty book before you buy. Write letter or postal NOW. Also include name of another fan.

BARAWIK CO., 542B Monroe St., CHICAGO, U. S. A.

The ADVANCE *fixed* CRYSTAL DETECTOR



Super-tested for sensitivity and permanent setting of gold point. Positively fixed. Finest construction. 85,000 now in use and giving perfect satisfaction. $1.50—at dealers or by mail prepaid. Send name of nearest dealer with remittance.

ADVANCE ELECTRIC CO., 1260 W. 2nd St., Los Angeles, Cal.

Insure your copy reaching you each month. Subscribe to Radio News—$2.50 a year. Experimenter Publishing Co., 53 Park Place, N. Y. C.

generally prove a better reproducer of low or bass notes than a small horn speaker.

We know that, to obtain the very best reproduction, we must employ a horn speaker with a very long horn, a cone

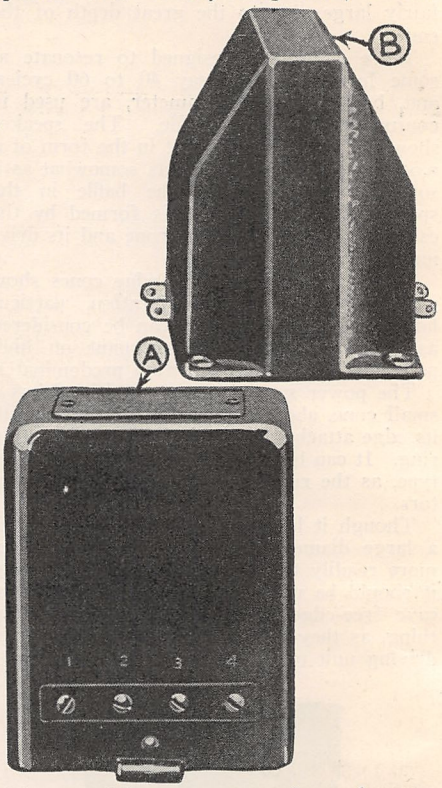


Fig. 12. A is an output transformer for use between the output of the audio amplifier and the loud-speaker. This transformer is very efficient on the higher frequencies, so there is no loss of overtones.

(*Photo courtesy of Silver-Marshall, Inc.*)

B is an output choke and serves a similar purpose. This choke is wound in a special manner, and is excellent because of its high impedance and low distributed capacity.

(*Photo courtesy of Samson Electric Company*)

speaker with a diaphragm of large diameter, or a small, free-edge concave cone capable of handling a great deal of power. In all events, a power amplifier is necessary; as the bass notes require an additional shove if they are to be made prominent. Furthermore, the audio-frequency amplifier must be capable of handling the range of musical frequencies without amplifying certain tones out of all proportion to others, as the loud-speaker certainly cannot make up for the deficiency, unless the frequency-characteristics of one are highest where those of the other are lowest, so that one compensates the other. As with any other article, it depends upon how much you can spend to obtain quality.

Before closing it is well to add that, in all cases, it is advantageous to employ either an output transformer (A in Fig 12) or an output choke (B in Fig. 12) connected between the output of the audio amplifier and the loud-speaker. This protects the magnet windings of the loud-speaker from damage and at the same time provides, in many cases, a better match in impedance between the last amplifier tube and the speaker.

AVERTING THE OMEN

A new type of radio-compass station has been put into operation at Destruction Island, Washington State, which is in the Pacific, west of the Olympia peninsula, south of the entrance to Puget Sound.

A SUPER-ENSEMBLE

When the National Union of School Orchestras went on the air at the Crystal Palace in London, 4,000 violinists—girls and boys—were heard by the listeners.

A Christmas Gift of Happiness

(*Continued from page* 638)

thought of money left over for the recreation which the younger children, especially the boys, would enjoy; and frequently the only diversion that these have, they have to find on the city streets. They are bright children and a radio set would be of particular value in keeping them at home and contented. (Cleveland.)

Case No. 15

A dear, bent old man with a "crook in his back and a melancholy crack in his laugh," —a veritable "last leaf upon the tree"— that's Mr. Daniels. But besides the crook and the crack there is a twinkle in his eye, harbinger of the very real humor that is his.

Then there is Mrs. Daniels who has neither crook nor twinkle, but is large and round and serious. Life to her is a solemn round of duties to be performed, of work to be done to care for her dear ones. Last but not least in this family is the twelve year old grandson, Frank, the pride of their eyes. It is he who makes life worth living for Mr. and Mrs. Daniels.

In the Daniels' household there is very little cheer excepting the quaint humor of the old man and the jazz from Frank's harmonica. If you doubt that he can play real jazz, be assured that he won third prize in the harmonica contest at the Y. M. C. A. last year with a jazz version of "America," which the papers declared, took the house by storm. Since then the boy has had many requests to play for others, but the old folks need him at home with them.

What a joy a radio outfit would bring to these three. (Cleveland.)

Case No. 16

Old Mrs. Sawyer is confined to her bed with chronic arthritis. Her husband is no longer able to hold a job, but has just strength enough to do a few necessary household tasks and to take care of his wife. Being confined in the home is beginning to tell on him. He seems to be losing his grasp on things and needs more than anything else, contact with the outside world. He is beset with fears that he and his wife will be separated. Almost his only visitor, aside from the Associated Charities' worker, is a brother who himself is an invalid, but who comes hobbling in when he can, to see the old couple. The pleasure that a radio set would bring to this home cannot be estimated. (Cleveland.)

Case No. 17

Chronic progressive arthritis, a worthless farm, and a sick wife are the discouragements that Mr. Romain faces. All day long he thinks of the future, yet he tries to be cheerful for the sake of his sick wife and their five children. An allowance from a social agency supplies the necessities, but there is little margin. Books from the Public Library and magazines are Mr. Romain's only recreation. The radio would help both Mr. and Mrs. Romain to pass the time away. It will be a real factor in making this home a happier one. (Minneapolis.)

Case No. 18

Mr. Brown is an ex-service man who had never had a day of illness until a year ago when he had infantile paralysis. But even then "it might be worse" for in another

Make Your Set Safe
With a
Belden Fused
Radio Battery Cord

FOR a perfect Radio Christmas, protect the new tubes and batteries, and also avoid fire hazard from crossed wires by hooking up your set with a Belden Fused Radio Battery Cord.

The tiny A and B battery fuses, concealed in the little two-piece bakelite shell, can be easily inspected.

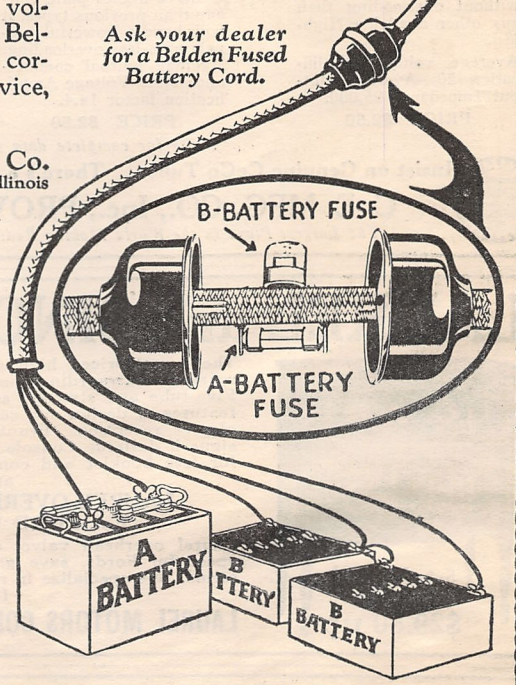
This handy cord also improves the appearance of the set and eliminates all loose wires.

For maximum range and volume, ask your dealer for a Beldenamel Aerial. It cannot corrode, even after years of service, and requires no cleaning.

Ask your dealer for a Belden Fused Battery Cord.

Belden Manufacturing Co.
2314A S. Western Ave., Chicago, Illinois

This is a Radio Christmas



Goodrich Silvertown Radio Panels

For greatest range and selectivity

1 Easier to drill and machine.
2 Better color, lasting lustre.
3 Lower free sulphur—no discoloration.
4 Higher softening point—no warping.

Goodrich V. T. Sockets *Spaghetti Tubing*
Radiophone Ear Cushions *Battery Mats*
Hard Rubber Tubes for Coils

The B. F. Goodrich Rubber Company
Established 1870 Akron, Ohio

Three New CeCo TUBES

That Will Make A Good Receiver *BETTER*

TYPE G HIGH MU

For use in impedance and resistance coupled receivers.

"CeCo" Type "G" tube will carry more power without overloading than any other available High-Mu.

Average voltage amplification 20—Average Output Impedance 25,000.

PRICE $2.50

TYPE H SPECIAL DETECTOR

Will give improved reproduction and avoid the usual rushing and hissing sounds of the "soft" detectors.

Using a higher plate voltage than previous types, it will handle powerful signals with less overloading. Average mutual conductance 940. Voltage Amplification factor 14.4.

PRICE $2.50

TYPE J-71 OUTPUT TUBE

Will handle sufficient power to operate the largest loud speakers at full volume. Does not require high voltage plate supply. At 90 v. it will give twelve times the undistorted power of the ordinary "A" type.

To be used in receivers where a separate "C" Battery connection for the last tube is furnished. Can be used on voltages up to 180 with enormous volume output, provided a special output circuit is used to protect the loud speaker. Filament 5 v.—½ A.

PRICE $6.00

Write for complete data sheet.

Insist on Genuine CeCo Tubes. There's a type for every radio need.

C. E. MFG. CO., Inc., PROVIDENCE, R. I.
The Largest Plant in the World Making Radio Tubes Exclusively

LAUREL and SINCLAIR RADIO RECEIVERS

5-tube and 6-tube $29.50 up

The lowest-priced high quality radio receiving sets on the market. Extraordinary selectivity, coast to coast reception. Five-tube and six-tube sets from $29.50 up. Many superior features of design and construction to bring better, stronger, clearer reception. Beautifully finished console cabinet designs if desired. Console cabinets only, $17.50 to $35. Write for free booklet and confidential discount sheet for dealers and salesmen.

LAUREL OVERHEAD VALVE SYSTEMS For FORD CARS and TRUCKS

Laurel overhead valve, cylinder-head permits 65 m. p. h. speed for Fords, save gas, increase power. Low cost, easy terms. We specialize in racing cars and racing heads. Write for circular.

LAUREL MOTORS CORP., Dep. V. R., Anderson, Indiana

Insure your copy reaching you each month. Subscribe to Radio News—$2.50 a year
Experimenter Publishing Co., 53 Park Place, N. Y. C.

year he can probably use his arm again. Meanwhile reading and chatting with his friends is his only recreation. What fun to to talk with friends about the latest radio program,—if he only had a radio set! (Minneapolis.)

Case No. 19

James Rutherford had an injury to his spine ten years ago. Ever since he has hoped that some day he could go back to work—a well man. But now he no longer hopes—he knows that all his remaining years will be spent as an invalid. Ruth and John, his little children, are glad father is to stay at home, but they little know what his days at home mean. Now that Mr. Rutherford can no longer hope to be well, his time must be occupied—a radio set will help. (Minneapolis.)

Case No. 20

Mrs. B. is a woman well past sixty. She is so badly crippled that it is practically impossible for her to go out. Her home is a tiny two-room house which, in spite of her crippled condition she keeps spotlessly clean. An unmarried brother of about her own age is her only relative. He works in a near-by city and comes to visit her on Sundays. Except for him her only companion is a tiny Polish girl, who speaks no English. Mrs. B. speaks no Polish, but the two are great friends. A radio would mean a new world and a new life to Mrs. B. (Philadelphia)

Case No. 21

Mrs. F.'s husband died of tuberculosis a short time ago and Mrs. F. herself is now threatened with the same disease. She was unusually attached to and dependent upon her husband, and his death has thrown her into a state of depression from which nothing seems to rouse her. She is deeply devoted to her two little girls and can hardly bear to let them out of her sight, even for school. Thus the children are constantly surrounded by an atmosphere of unhappiness. They have no fun at all, as Mrs. F. considers it impossible for her to go out for any form of recreation. A radio would have a therapeutic value in this family and would also bring a bit of cheer into their drab life. (Philadelphia.)

Case No. 22

Mr. L. is a well-educated and intelligent Greek, who has incurable heart disease and one year ago became totally disabled. He must govern his days very carefully and follow strict routine. Prior to his illness he was much interested in his work as an engraver and was exceedingly active in all of his countrymen's affairs and social gatherings. Since his enforced idleness he has lost heart and courage, and there are many hours when there is not much else to do but think of the far happier days that have past. Although there are three little ones all under three years of age, Mrs. L. makes a determined effort to keep her family together, plying her trade as seamstress. This home has little to offer in the way of recreation, and a radio would not only give them a great deal of pleasure, but would also be a real benefit to Mr. L. in diverting his mind into happier channels. (Philadelphia)

Case No. 23

Six years ago Mr. G. was in an accident which resulted in severe spinal injuries. Although he underwent long and painful medical treatment, it has been impossible for him to resume his former responsibilities. Mrs. G. has courageously tried to take his place as wage earner, and besides her house work and personal care for Mr. G. and her children, she sews for various tailoring establishments. When Mr. G. was well he had many outside interests; but since he has been confined to a chair it has become a fight to ward off melancholy and depression. A radio would bring him in touch with the out-

side world again and would be a help in overcoming hours of discouragement (Philadelphia)

Case No. 24

Mr. M. with his wife and small son came to America twenty-eight years ago. They adjusted quickly to American ideals and life and in a short time owned a little farm in the country. Nine years ago Mr. M. was stricken with osteomyelitis (inflammation of the bone marrow) and since then he has not been able to work. Their only child, Paul, died when Mr. M. was critically ill; so that the burden of supporting herself and her husband fell upon Mrs. M. She made a determined effort to keep their little home together, but it was a losing fight and they were forced to sell the farm. Last January Mrs. M. met with an accident that injured her entire left side. She was in a hospital for over six months and it will be many more months—perhaps never, on account of her age—before she will recover. Both Mr. and Mrs. M. are therefore shut-ins. Their home is a two-room bandbox dwelling in a tiny side court. There is very little opportunity for them to see anything of the outside world. Their life is an empty one indeed and there are times when the old couple are very lonely. A radio would give them a new interest in life and help brighten their declining years. (Philadelphia)

Case No. 25

Crippled so badly that he will never be able to work regularly again, Mr. J. has become discouraged and depressed. And it is no wonder for he has a delicate wife and three of his six little children are ill. Recently arrangements were made for him to do a little work at home a few hours each day. A radio would help a great deal to interest and encourage him in the long in-between hours. (Philadelphia)

Case No. 26

Last spring Mr. O. contracted tuberculosis and his prognosis is a very doubtful one. He probably will never again be anything but a confirmed invalid. The sudden change from an active to a passive life has been exceedingly hard on him. He is very distraught and unhappy. There are three small children, and the mother, who is not strong, has the burden of being both mother and father to them. This home sadly needs the brightness and cheer that a radio would bring. (Philadelphia)

Case No. 27

Mrs. A. is a widow, well along in years, who is suffering from tuberculosis. She is so attached to her home and her only son, who has always been frail, that the doctor has not recommended sanatorium care for her. Always a very neat person with the best housekeeping standards, she is in no way a menace to other people. Her son has never been well enough to work until very recently; and now he is making a successful struggle to overcome the inertia of the years of enforced idleness. His illness has kept him from making friends, so he has very little social life. A radio would bring a great deal of enjoyment to this spirited little old lady and her frail son. (Philadelphia)

Case No. 28

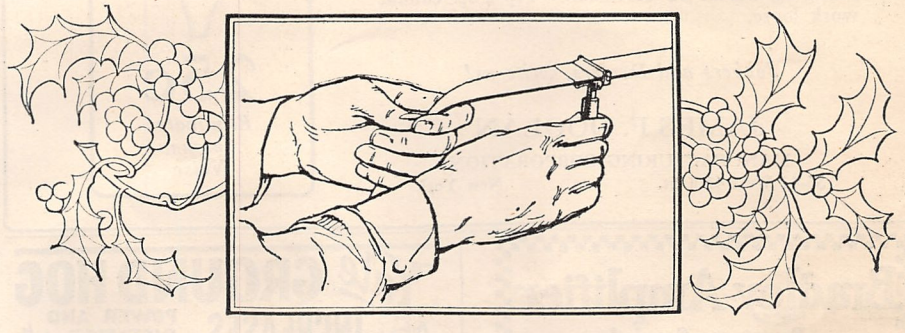
For four years Mr. T. has suffered constant pain from an incurable disease, and now he is mourning for his wife who died after a day's illness in a hospital. However, he has not been completely overwhelmed by his troubles and he is determined to make a home for his two little boys. One of them has tested well above the average of intelligence and the other has artistic ability, which he has inherited from his father. A radio would bring hours of forgetfulness to Mr. T., who bears his pain like a stoic, and a great deal of pleasure to the little boys. (Philadelphia)

A Gift for Any Man

Valet AutoStrop Safety Razor is the Ideal Xmas gift. For the young man beginning to shave—or for the older man, who, thru habit, daily pursues old, unsatisfactory shaving methods.

Valet AutoStrop Razor is the only razor in the world that sharpens its own blades, thus ensuring a new, keen edge for every shave. Each set is complete with Case, Razor Strop and Blades.

PRICES $5.00 *TO* $25.00



The Razor That Sharpens Itself.

Valet AutoStrop Razor

REG. U. S. PAT. OFF.

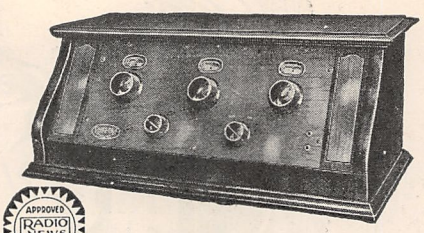
AUTO STROP SAFETY RAZOR CO., 656 First Avenue, NEW YORK CITY

CHELSEA

The New Super-Six $60

No Receiver at any price can offer more radio than the new Chelsea Super-Six with its wonderful Truphonic circuit, two-tone mahogany finish cabinet and other features found only in the most expensive sets. See and Hear it. At Your Dealers.

Write for Details

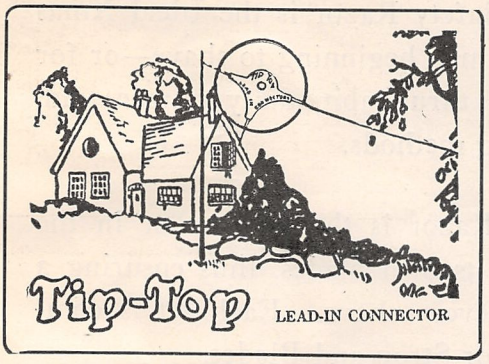


Specifications

6-tubes Truphonic construction, Built for Power Tube operation. Circuit fully shielded. Dust-proof, fool-proof inside panel protecting chassis. Rugged bus-wiring, hand-soldered connections. Cord leads for making all connections. Dimensions 21½ x 9 x 11½.

Other Chelsea Receivers—3 tubes $26; 5 tubes $50; 7 tubes deluxe $125.

CHELSEA RADIO CO., Chelsea, Mass.



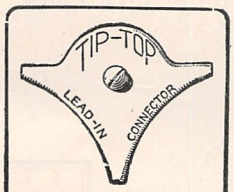
Tip-Top LEAD-IN CONNECTOR

Don't Neglect this Vital Point of Contact!

A FEW spare moments, a screw driver, and you have sure, perfect connection between your aerial and lead-in wire. No noise, no soldering, no loss of "distance" due to swinging aerial or corrosion. Tip-Top cannot work loose.

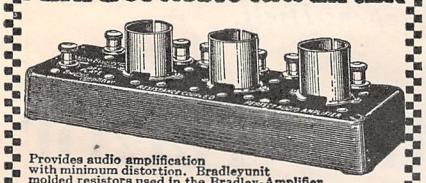
Jobbers and Dealers, write us!

JAMES F. DOOLAN
MANUFACTURING CORPORATION
36-42 West 47th St. New York



25c
Eliminates Antenna Noise

Bradley-Amplifier
Resistance-Coupled
PERFECT AUDIO AMPLIFIER



Provides audio amplification with minimum distortion. Bradleyunit molded resistors used in the Bradley-Amplifier do not vary with age and are not affected by atmospheric conditions. Can be used to replace transformer amplifiers in standard radio sets with decided increase in tone quality.

Allen-Bradley Co.
Electric Controlling Apparatus
287 Greenfield Avenue Milwaukee, Wis.

Yale GROUND HOG
"The Perfect Ground"
INCREASES POWER AND DISTANCE

Marvelous newly-invented ground gives incredibly improved reception. Doubles power and distance users say. Reduces leakage. Stops jangling even in midsummer. Results never before equalled. Satisfaction guaranteed or money back at once.
Proven absolutely essential to clear, powerful distance reception. Draws and holds moisture indefinitely. Highly sensitive to radio energy.

HIGHEST APPROVAL

Approved by Radio News exhaustive laboratory test and endorsed by other high scientific radio authorities.

SEND NO MONEY—To introduce, we offer to those who act at once, regular $5.00 size for only $2.00. Send name today and pay $2.00 plus 17c postage on delivery. Or send only $2.00 with order and save postage. FREE—Full description of Ground Hog and details of amazing special low priced battery offer on request—write today.
Yale Specialty Supply Co.
125 W. 5th St., Kan. City

Case No. 29

Mr. D. is all but totally blind. He can distinguish large objects, but does not have enough vision to find his way about the house in safety. He has had the best medical care, and the doctors say he will never recover his lost vision and that eventually he will be totally blind. However, Mr. D., like so many people who are similarly afflicted, cannot accept the doctor's prognosis and lives in constant hope of being able to return to his work so that he can support his family. He is not willing to take up occupational therapy because that would mean giving in to the fact that he cannot make money. All of this means that he is a very unhappy person in the throes of making a most difficult adjustment. A radio would take his mind off his troubles and also be a source of great pleasure to his wife and eight children. (Philadelphia).

Case No. 30

Mr. S. is suffering from heart trouble and his doctor has recommended complete rest in bed. He has always led a very active life and he finds the long hours of idleness almost more than he can bear. He worries and broods and this reacts disastrously on his heart. His only chance of recovery is to continue the present treatment for several months and be entirely free from worry and anxiety. A radio would be a new interest and for this man might be a means of preventing a chronic heart condition. (Philadelphia)

Case No. 31

Mrs. C. is an educated German woman who has been in this country thirteen years. For six years she has suffered with an incurable disease, which has affected her in such a way that she is not able to walk. After her illness they had to give up their comfortable home, and now they are living in two rooms in a neighborhood removed from their old friends, which means that Mrs. C. has almost no social contacts. Her only child is a daughter, nineteen years old, who has secured special training by going to school in the evening, while she did unskilled work during the day. She is devoted to her mother and takes the best of care of her. A radio would bring a great deal of cheer to this woman, who is virtually a shut-in; and it would be a source of pleasure to her conscientious, devoted daughter. (Philadelphia)

Case No. 32

Mrs. H., English born and bred, crippled, without friends or relatives, is living alone in a little room crowded with what remains of the cherished possessions of better days. She lives almost entirely in the past which was so great a contrast to the present—English army life, gay balls and parties, attendant to a lady of quality at court, her coming to America, the death of her husband and her own skill and success in caring for herself as a dressmaker. The brightness of the past makes the inevitable and necessary return to the practical details of daily living all the harder. A radio would give to the present something of the pleasure and glamour, which are associated with the past and give life and color to days that pass monotonously, since too often, even to seventy-seven, dreams of the past are not sufficient to satisfy the lacks of the present. (Philadelphia)

Case No. 33

Mrs. M. is an exquisite gentlewoman of the old school, 70 years old, living alone, and even at her age partially supporting herself by china painting. She is a very refined, sensitive, music-loving American woman. (San Francisco)

Case No. 34

Mr. N. an old seafaring man, has not

been able to work for several years. He cannot leave his home at all. His wife cares for him and does a little work in the home. They have no pleasures excepting what friends can bring to them. This is a very nice old couple, of Danish-English descent. (San Francisco)

Case No. 35

Mrs. H. a very sweet, refined woman of over 70 years of age, lost her only son years ago and is alone in the world. Her chief pleasure is religious correspondence with prisoners in San Quentin and elsewhere. She is shut off from ordinary intercourse by being somewhat hard of hearing, but she could, and would, greatly enjoy the music over the radio. (San Francisco)

Case No. 36

Mr. H., of American-Danish descent, was a sea captain until he became paralyzed. Mrs. H. was a noted actress in her time. A couple of years ago she had an acute attack of influenza which left her with a heart weakness. This couple are shut-ins—cared for by friends and by the Associated Charities. They are refined, appreciative people. (San Francisco)

Case No. 37

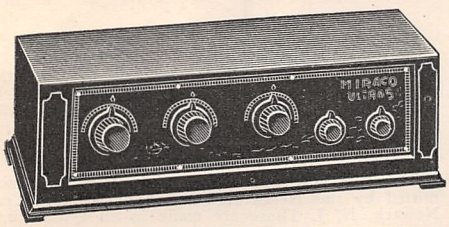
This is a high-type family who have been most unfortunate. Mr. E. has tubercular peritonitis and the possibility of his cure is very slight. Mrs. E. is a fine woman, who cares for her husband and four children. They are entirely dependent and, while of course the necessities of life are provided for them, it is impossible for them to have and enjoy many of the pleasures. A radio would be greatly appreciated in this family. (San Francisco)

Radio News Laboratories

(*Continued from page 677*)

FIVE-TUBE RECEIVER

The "Miraco Ultra-5" Radio Receiver, submitted by the Midwest Radio Corp., Cincinnati, Ohio, is of the three-dial five-tube tuned-R.F.

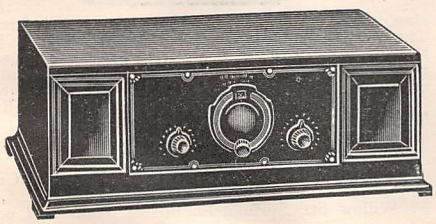


type including a two-stage transformer-coupled audio amplifier. The set is well built and performs admirably.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1603.

SINGLE-CONTROL RADIO RECEIVER

The "Miraco Unitone 5" Radio Receiver shown, submitted by the Midwest Radio Corp., Cin-

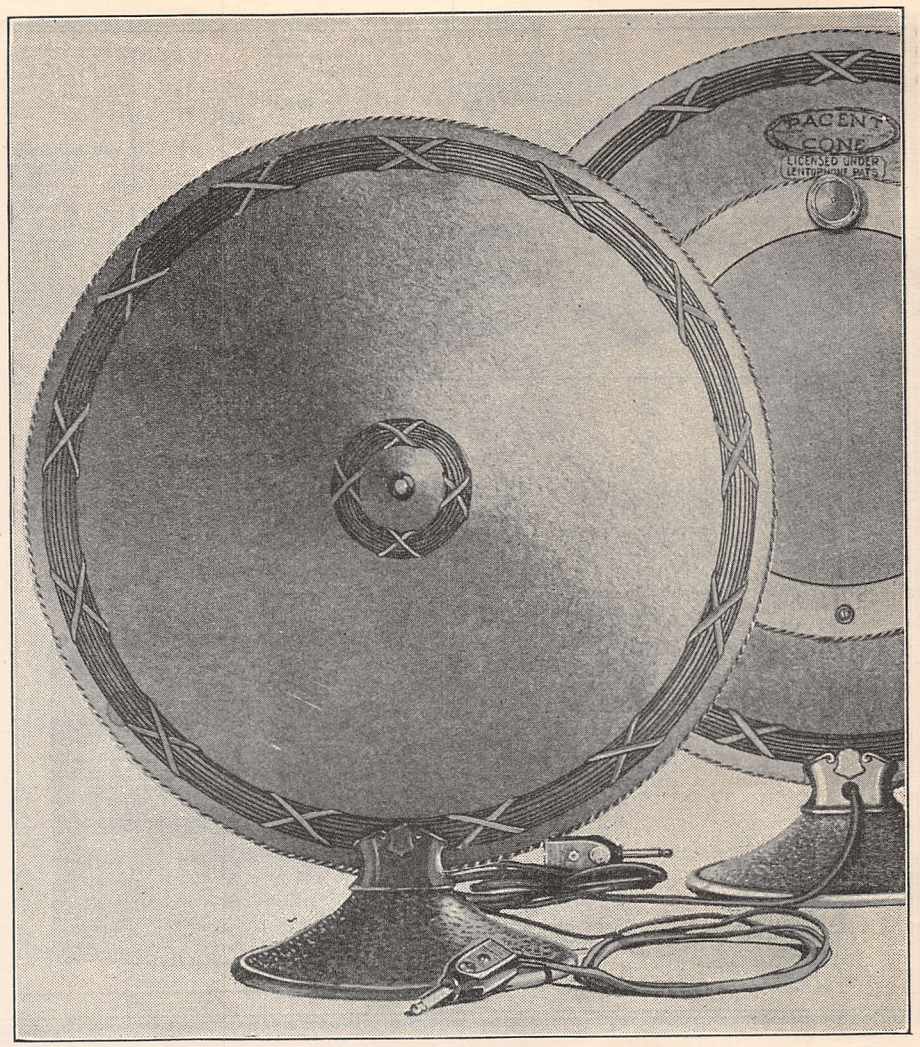


cinnati, Ohio, differs from the Ultra set described above, in that the three tuning condensers are controlled by one dial.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1604.

LOUD-SPEAKER

The "Pausin" Loud-Speaker shown, submitted by the Pausin Engineering Co., Newark, N. J. It is of the cone type, with the diaphragm enclosed in a metal cabinet with openings in the front. Besides being ornamental the cabinet protects the apparatus from mechanical injury. This speaker has excellent tonal qualities.



Type A Pacent Cone, 17 inches in diameter. Manufactured under Lektophone Patents.

The

Immediate Success

of the

PACENT CONE

THIS remarkable new development of the Pacent engineers reproduces the delicate inflections of the human voice and musical programs with such startling truth and clearness that it has met with *immediate success* among radio users.

Its tone range is practically unlimited, and it can be used with any receiving set, with or without power amplification. A superior sound reproducing device from the standpoint of absolute fidelity, crystal clarity and above all, musical range.

All types are equipped with a suitable length cord and Pacent detachable plug.

Type A, table type, 17 inches, with handsome bronze base. List price $28.50
($31.50, West of the Rockies)

Type SA, 36 inches, mounted on American Walnut stand for floor use. List Price $89.50
(Slightly higher West of the Rockies)

Type WA, similar to Type SA, but designed for mounting on wall. List Price $78.50
(Slightly higher West of the Rockies)

If your dealer cannot supply you, write us for interesting and informing literature.

PACENT
Radio Corporation
156 West 16th Street
New York City

FREE BOOKLET

32 pages of interesting reading on care and upkeep of radio.

ASK FOR YOUR COPY

Sterling

"B" & "C" Power

MORE THAN AN ELIMINATOR OF BATTERIES--

A GREATER CONVENIENCE AND POWER PRODUCER

Here is one of the interesting new devices you will find explained in our booklet.
Compare the Sterling "B" Power with any eliminator for output, flexibility, convenience and construction—it can't be equalled.

Sterling No. 97, delivers up to 180 volts at 50 milliamperes; is especially recommended for sets using the new No. 171 or 210 power tubes; has two power-ranges with cut-off switch; uses the improved type Raytheon Tube.

No. R-97 "B" and "C" Power, complete with tube, price $55.00.

No. R-99 "B" Power, complete with tube, price $45.00.

Other types, Television design, with tube. Prices $26.00 and $28.00.

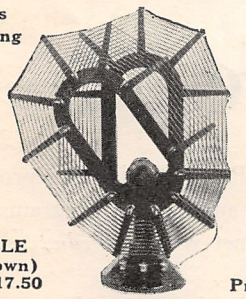
RADIO PROTECTION Sterling EQUIPMENT

THE STERLING MFG. CO.
Cleveland, Ohio

BIG SENSATIONS OF THE "RADIO WORLD'S FAIR"

TUN-A-LOOP

Pat's Pending



DOUBLE (as shown) Price $17.50

SINGLE Price $12.50

What TUN-A-LOOP does; works all waves, increases volume, clarity, selectivity, directional effect, cuts out 2nd Harmonics, reduces static, works only on peak of wave, no dead end loss.

ENGLISH-WHITMAN SPEAKER

Pat's Pending

18-INCH DIAPHRAGMS

PRICE $35.00

No paper, no cone, no horn, powerful unit, double compound action different from any other speaker on the market. Volume, clarity, soft mellow tone.

IF YOUR DEALER CANNOT SUPPLY YOU WRITE OR WIRE DIRECT

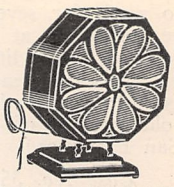
ENGLISH-WHITMAN PRODUCTS INC., 120 BROADWAY DEPT. R.N., NEW YORK

ARE YOU FAIR TO YOUR SON? YOUR DAUGHTER?

There are many things they should know, many menacing dangers they can avoid by a little knowledge. It is up to you to teach them.

"YOUR BODY" the new book, tells all you need to know—50c EVERYWHERE

EXPERIMENTER PUB. CO., Inc., 53 Park Place, New York City



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1633.

VACUUM TUBE

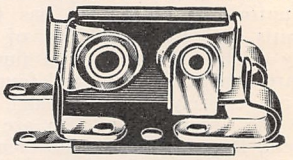
The "Cecilian" Vacuum Tube shown, submitted by the Esetroc Mfg. Co., 28 Longworth St., Newark, N. J., is of type 201A and employs the

modern UX-type bakelite base; its characteristics are similar to those of the average 6-volt ¼-ampere tube.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1634.

FIXED CONDENSER

The .01-mf. "Wizard" Condenser shown, submitted by the Wizard Co., Jamaica Plain, Mass., is equipped with spring clips into which may be

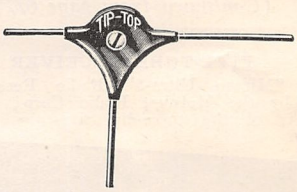


inserted a coupling resistance and a grid leak.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1635.

AERIAL CONNECTOR

The "Tip Top" Aerial Connector shown, submitted by the James F. Doolan Mfg. Corp., 36 West 47th St., New York City, effects excellent

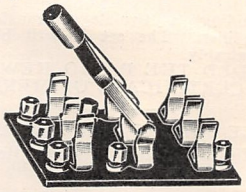


electrical contact between the lead-in and the antenna wire without the use of solder.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1636

KNIFE SWITCHES

The "Radiant" Knife Switch shown was submitted by the Heath Radio & Electric Mfg. Co., Newark, N. J. These are made in all types from

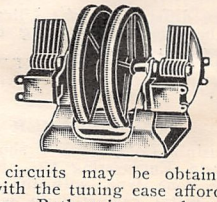


single-pole single-throw to four-pole double-throw. These little switches, measuring only 5/8-inch between blades, will be found very useful on many radio installations. The clips are rigidly mounted on a bakelite base.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1637.

DOUBLE CONDENSER

The "Na-Ald Double Localized Control" Condenser shown was submitted by the Alden Mfg. Co., 54 Willow St., Springfield, Mass. Individual con-

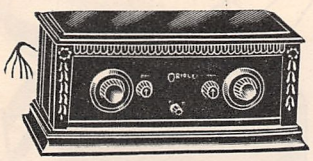


trol of two circuits may be obtained with this instrument, with the tuning ease afforded by single-control devices. Both units may be turned as one, with one hand, or each one separately

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1641.

TUNED-R.F. RADIO RECEIVER

The "Oriole Trinum" Radio Receiver shown, submitted for test by the W-K Electric Co., Kenosha, Wis., contains two stages of tuned R.F. amplification, detector, and two stages of audio am-



plification. Two of the tuning condensers are mounted in tandem, so that only two tuning controls are required. It is an excellent broadcast receiver.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1642.

HYDROMETER

The Model 10 "Smash Pruf" Hydrometer shown, submitted by the Acid Supply Utilities, 316 West

24th St., Chicago, Ill., is well designed and accurate. A rubber stop at the upper end of the tube prevents the float from passing up into the bulb.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1643.

ABSORBER SOCKET

The UX-type Absorber Socket shown, submitted by the Bremer-Tully Mfg. Co., 532 So. Canal St., Chicago, Ill., is of the non-microphonic type. The

central portion, which carries the tube, is supported on a sponge rubber absorber, and flexible leads connect the spring contacts to the terminals.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1644.

RHEOSTAT DIAL

The "Mar-Co" Dial shown, submitted by the Martin-Copeland Co., Providence, R. I., is 2¼

inches in diameter and designed to harmonize with the larger "Mar-Co" vernier dials. This instrument, however, is not of the vernier type; it is for use on rheostats and other similar instruments.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1645.

CUSHIONING TUBE SOCKET

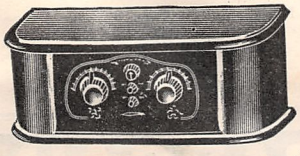
The "Sofrubba" Socket shown was submitted by the Moulded Products Corp., 549 West 52 Street,

New York City. One method of reducing vibration of a tube is to make the entire tube socket of soft rubber. The socket illustrated is so made and the construction proved very effective.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1648.

TUNED-R.F. RADIO RECEIVER

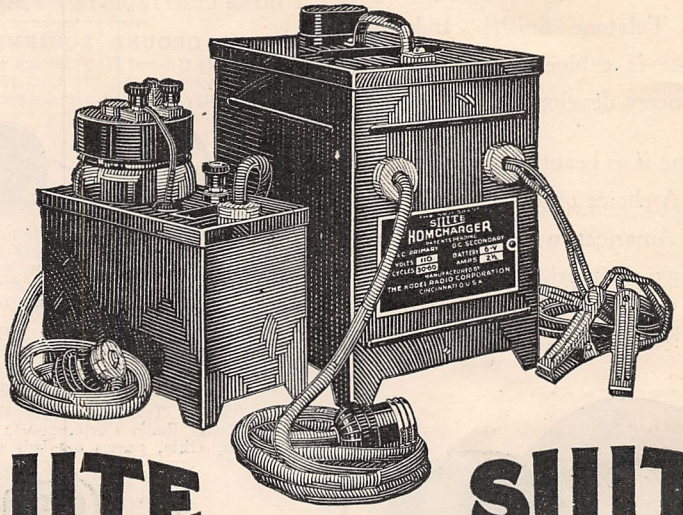
The "Arborphone" Radio Receiver shown, submitted by the Precision Products Co., Ann Ar-



bor, Mich., is of the 5-tube type; employing "pancake" type R.F. transformers and a two-stage transformer-coupled amplifier with provisions for a power tube in the last stage. Two of the tuning condensers are mounted in line, with the knobs together, so that either one or both can be turned with one hand.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1649.

A-B & C Light Socket Power



SILITE TRICKLE CHARGER

SILITE HOMCHARGER

Your battery troubles are over, at last. Now all radio power is in your light socket.

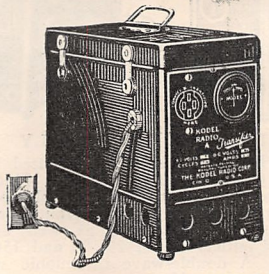
For continuous unfailing "A" current, connect either the Silite Homcharger or the Silite Trickle Charger to your present storage battery. Absolutely noiseless, without bulbs, moving parts, or adjustments, Silite Trickle Charger makes a power unit of your battery—keeps it always at top efficiency. Left permanently on charge, Silite Trickle converts light socket current into radio power and stores it in your battery ready for use at any time—you simply forget about battery charging forever. For exceptionally large sets where a high charging rate is necessary, the Silite Homcharger is recommended. Either model may be used while the set is operating.

SILITE TRICKLE CHARGER
.6 ampere charging rate.
Complete.....$10.00

SILITE HOMCHARGER
2½-3 ampere charging rate.
Complete.....$19.50

Kodel A&B Transifiers

Kodel A and B Transifiers actually deliver all A, B, and C current direct from the light socket—smooth, constant, never-failing power that operates your set always at its greatest efficiency. Vastly different from and superior to the ordinary power unit, Kodel Transifiers consume current only while the set is operating—maintenance cost is less than one-half cent for every hour you use your set. Any radio dealer can show you Silite Battery Chargers and Kodel Transifiers.



MODEL 10 "A" TRANSIFIER
Supplies 2, 4, or 6-volts "A" current direct from the light socket. For sets using up to 10 tubes..... $42.50

MODEL 10 "B" TRANSIFIER
22½ to 150 volts "B" current; 4 to 10 volts "C" current for any size set. Operates power tubes..... $42.50

MODEL 61 "B" TRANSIFIER
22½ to 90 volts noiseless "B" power for sets up to 6 tubes..... $28.50
(Bulbs extra)

"Behind the Scenes in a Broadcasting Station" an interesting 24-page booklet, will be mailed free on request, together with literature describing Silite Chargers and Kodel Transifiers.

The Kodel Radio Corporation, 501 E. Pearl St., Cincinnati, O.
Owners and Operators of Broadcasting Station WKRC

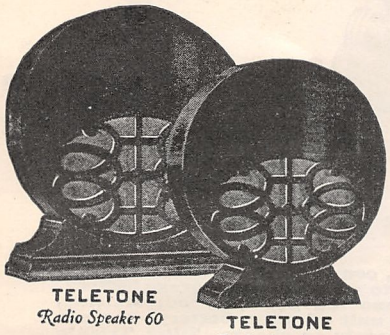
Battery Chargers Power Units **KODEL** *Radio Receivers Loud Speakers*
POWER SPECIALISTS SINCE 1912

TELETONE

is furniture as well!

How the wondrous grains of the woods are brought out by the superb Teletone finish! Indeed, Teletone is cabinet-making in its most sincere development.

Teletone is as beautiful to see as to hear. A choice of African mahogany or American walnut, in either of the two sizes, priced conveniently at $32.50 and $22.50.



TELETONE *Radio Speaker 60*

TELETONE *Radio Speaker 62*

On Sale at your Dealers.

Teletone Corporation *of* America

449-453 West 42nd Street
New York City

TELETONE
Radio Speaker
BUILT LIKE A VIOLIN

6 Volt

STORAGE RADIO "A" BATTERY

Most amazing battery value ever offered! A genuine World 6-volt Radio "A" Battery with 25 ampere capacity for only **$5!** It is just the thing for Trickle charger. Famous World Quality assured. Equipped with

$5.00 C. O. D Send No Money

Solid Rubber Case

An assurance against acid and leakage. Order shipped same day—subject to your examination on arrival. Extra offer: 5% discount for cash in full with order. ACT TODAY!

WORLD BATTERY COMPANY
1219 S. Wabash Ave. Dept. 110 Chicago, Ill.

"B" ELIMINATOR

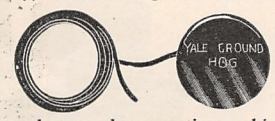
The "B" Eliminator shown, submitted by the George Electric Co., Carleton and University Ave., St. Paul, Minn., houses the conventional filters,

transformer and double-wave gas-type rectifier tube within its metal case. An ample supply of plate current with 45, 90 and 145 volt outlets is obtained.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1650.

GROUND EQUIPMENT

The "Yale Ground Hog" shown was submitted by the Yale Specialty Supply Co., 123 West 5th St., Kansas City, Mo. Long-distance reception re-

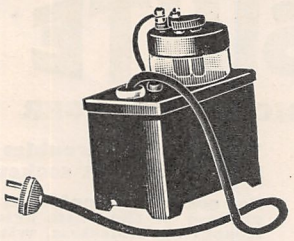


quires a good ground connection, which may be obtained by burying the copper disc, illustrated, in the earth. The chemicals contained in the instrument decreases the resistance of the earth in the vicinity, and insure a low-resistance ground connection.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1653.

TRICKLE CHARGER

The "Silite" Trickle Charger shown, submitted by the Kodel Radio Corp., 507-13 East Pearl St., Cincinnati, Ohio, passes one-half to three-quarters



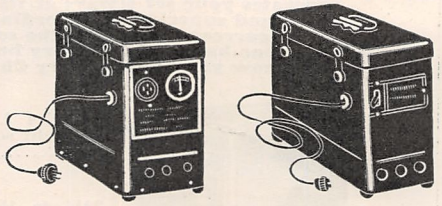
of an ampere through a 4- or 6-volt storage "A" battery. It operates directly from a 110-volt 60-cycle line, a special chemical rectifier being used to convert the current.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1654.

A POWER SUPPLY

The "A" "Transifier" shown, submitted for test by the Kodel Radio Corp., 507-13 East Pearl St., Cincinnati, Ohio, is of similar external appearance to the Kodel "B" Eliminator. It contains the necessary transformers, with the usual six-volt storage battery on floating charge, fed from the A.C. line through a Tungar rectifier tube.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1655.



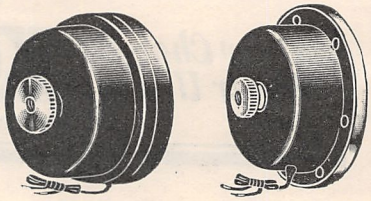
"B AND C" POWER SUPPLY

The "B" "Transifier" shown, submitted by the Kodel Radio Corp., 507-13 Pearl St., Cincinnati, Ohio, operates directly from a 110-volt, 60-cycle line and supplies ample "B" current for from four to ten 201-A-type tubes, as well as "C" potential; "B" outlets of 45, 70, 90 and 150 volts are provided. A double-wave thermionic vacuum tube is used as a rectifier.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1656.

LOUD-SPEAKER UNIT

The "Operola" Loud-Speaker Units shown (types B and C) submitted by the Zisch Engineer-



Reception *Not Deception*

Volume, not noise. **Tone,** not blare. Clear, mellow, perfect reception of every sound from a whisper to a full orchestra. That's what radio enthusiasts everywhere are enjoying with the new Dulce-Tone, the perfected radio-talking-machine-speaker. Dulce-Tone, for $10, and your phonograph make the finest loud speaker money can buy. Try it and see. Your money back if you're not completely satisfied. At your dealer's, or send the coupon.

THE GENERAL INDUSTRIES COMPANY
Formerly named The General Phonograph Mfg. Co.
251 Taylor Street **Elyria, Ohio**

Dulce-Tone

Enclosed is $10 for my Dulce-Tone. If I'm not satisfied after 10 days' trial, I'll return it and get my money back.
Name .....
Street .....
City ..... State.....

R. E. LACAULT, E.E., I.R.E.
Originator of the famous

ULTRADYNE

Presents his latest treatise entitled

SUPER HETERODYNE CONSTRUCTION AND OPERATION

In this book Mr. Lacault gives comprehensive and informative data most valuable to owners of Super Heterodyne and other receivers. In addition to this Mr. Lacault reveals for the first time the diagrams and full constructional details of his latest design—

The new super sensitive 9 tube

L R 4

This new receiver embodies the last word in Radio efficiency and the information regarding this receiver is worth the price of the book alone without taking into consideration the valuable information contained on

The how and why of each part
Super Heterodyne trouble shooting chart
How to improve your present set
How to check and match your tubes
How to build a power amplifier, etc.

Mail your order today! Price $1.97

R. E. LACAULT RADIO ELECTRIC LABORATORIES
Dept. 1A—1931 Broadway, New York City

BARGAINS!

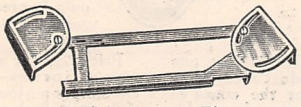
SAVE 1/3 TO 1/2
WRITE FOR CATALOG
RANDOLPH RADIO CORP.
180 N. UNION AV. Dept. 2 CHICAGO, ILL.

ing Corp., 39-43 Avenue L, Newark, N. J., are of similar construction to the phonograph attachment previously described, except that the base is eliminated. One of these instruments is housed in a metal case and the other in a composition case.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1557.

ADJUSTABLE SHELF BRACKETS

The Adjustable Shelf Brackets shown, submitted by Benjamin Products, 120-128 So. Sangamon St., Chicago, Ill., are of unique design and the adjustable feature employed makes them adaptable to

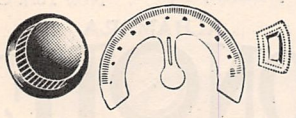


practically any type of set. The arrangement is such that the panel may be mounted at an angle if desired.

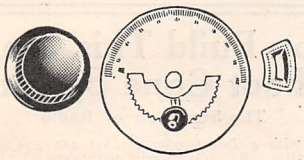
AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1661.

DIALS

The types 104 and 180 "Dialiers" shown, submitted by W. F. Loughman, 161 High St.,



Boston, Mass., are for back-of-panel mounting. One is of the vernier type. A bezel is furnished



with each, for mounting on the panel.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1662.

The "White Cross Dialier" shown, submitted by W. F. Loughman, 161 High St., Boston, Mass.,

is of the vernier type, having a ratio of about three to one. The friction drive employed prevents back lash. The diameter is 3¾ inches.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1663.

KNOB SWITCHES

The Right-Angle Switch shown, submitted by the Saturn Mfg. & Sales Co., 48 Beekman St., New York City, works by means of a cam attached to the knob. It is neat in appearance.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1664.

The Utility Switch, submitted by the Saturn Mfg. & Sales Co., 48 Beekman St., New York City, is of similar construction to the right-angle switch described above except that it has three blades and may be used wherever a single-pole double-throw switch is required.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1665.

SHORT JACK

The Short Jack shown was submitted by the Saturn Mfg. & Sales Co., 48 Beekman St., New York City. Where space is limited, it may be used

to advantage. It protrudes only 5/8-inch behind the panel, and the phosphor-bronze spring insures perfect contact.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1666.

UX TUBE SOCKET

The "Sure Grip" Socket shown, submitted by Hart and Hegeman Co., 342 Capitol Ave., Hartford, Conn., is well constructed of bakelite. The rubber cushion at the center of the top of the instrument prevents injury to the tube by forcing it too far into the socket.

The New Triple Duty GOLD SEAL HOMCHARGER

The World's Most Popular Battery Charger

$19.50 Complete

Charges three times faster! Rejuvenates lifeless tubes - supplies current for 8-volt power tubes!

It's more than just a battery charger—the new Triple Duty Gold Seal Homcharger. Charges three times as fast as other chargers — fully charges the average battery overnight. No bulbs — no liquids — Homcharger can be used for charging automobile batteries, too!

An exclusive Homcharger feature this season is the new tube rejuvenation process. Terminals are provided for bringing old radio tubes back to life without removing them from the set.

Homcharger may also be used as a power unit for 8-volt A. C. power tubes. Provides uniform light socket current for operating these tubes.

Only Homcharger offers these exclusive features—still Homcharger costs no more than ordinary battery chargers. Any radio dealer can show you the new Triple Duty Gold Seal Homcharger.

"Behind the Scenes in a Broadcasting Station" an interesting 24-page booklet, will be mailed free on request, together with literature describing the Triple Duty Gold Seal Homcharger.

The Kodel Radio Corporation, 501 E. Pearl St., **Cincinnati, O.**

Owners and Operators of Broadcasting Station WKRC

Battery Chargers Power Units **KODEL** *Radio Receivers Loud Speakers*

POWER SPECIALISTS SINCE 1912

VALET "AutoStrop" RAZOR FREE

Send $1 for 5 months' subscription to SCIENCE & INVENTION and receive one genuine VALET RAZOR FREE

EXPERIMENTER PUB. CO., Inc., 53 Park Place, New York City

FREE — OUR 84-PAGE CATALOGUE. FILLED WITH RADIO BARGAINS. WRITE TODAY!

RANDOLPH RADIO CORP.

180 N. UNION AV. Dept. 2 CHICAGO, ILL.

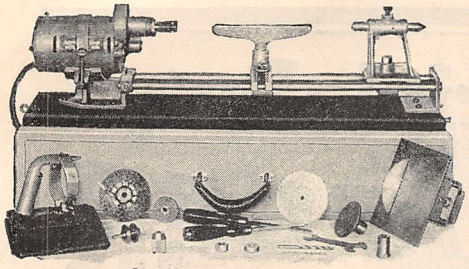
FREE RADIO GUIDE

LATEST HOOK-UPS

164-PAGE (1927) GUIDE

Gives special hook-ups with illustrations. Shows big savings on standard radio parts, complete sets, kits. Be sure to get this thrifty book before you buy. Write letter or postal NOW. Also include name of another fan.

BARAWIK CO., 542B Monroe St., CHICAGO, U. S. A.

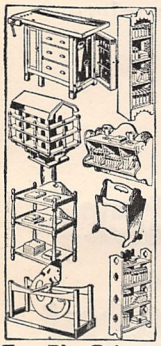


NEW ELECTRIC Speed Way Shop & Tools

A compact and efficient electric work shop for the man who loves to make and create handiwork. Driven by the famous Speed-Way Motor which is interchangeable among

8 Motor Driven Tools

A complete woodturning **lathe, bench saw, scroll or jig saw,** a portable electric **hand saw** and all accessories for both portable and stationary power **drilling, buffing, grinding** and **cleaning.** Attaches to any light socket and converts a work bench into a complete private tool and machine shop. Have the chips flying in five minutes after receipt.



Make Things at Home

You can make and build almost anything — attractive furniture novelties, lawn decorations, toys and playground apparatus—do experimental jobs in radio—perfect inventions and countless other things.

Only $10 Down

Our literature covers ten different assemblies of Speed-Way Shops and four useful electric accessories. Select as much equipment as you desire. Our payment plan makes owning a shop easy.

10 Days' Trial

You can test this shop for 10 days in your own home. If it does less than we claim, return it.

Free Blue Prints
Write for list of working blue-prints that we furnish free with each electric shop.

Write for full information

Every tool is high grade for regular work. A shop is a money maker for the small job man. Write for complete information.

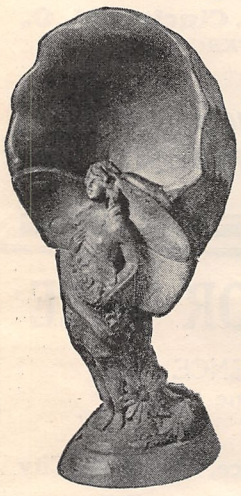
Electro-Magnetic Tool Company
1830 S. 52d Av., Cicero, Ill. (Adjoining Chicago)

Manager, Dept. 2212. Please send me particulars about 10-day free trial, free blue-prints and $10 down payment.

NAME .....

ADDRESS .....

"The Voice from the Sky" Loud Speaker



"THE MOST BEAUTIFUL SPEAKER IN THE MARKET." —different from any other.

The **"Voice From the Sky"** speaker is scientifically constructed, cast in one solid piece, of materials which have the property to eliminate useless noises. It produces a clear, soft, and pleasant acoustical rendition in a manner not yet attained by any other loud speaker. Overall height 24". Bell diameter 12". Finished in walnut, mahogany.

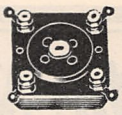
List Price, $30 **"No Vibration"**

Write for further information and discounts

MANUFACTURED BY

Florentine Art Productions, Inc.,
838 W. Austin Avenue Chicago, Ill.

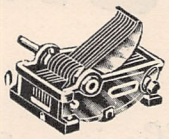
Insure your copy reaching you each month. Subscribe to RADIO NEWS — $2.50 a year. Experimenter Publishing Co., 53 Park Pl., N. Y. C.



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1668.

VARIABLE CONDENSER

The 17-plate Variable Condenser shown, submitted by Hart and Hegeman, 342 Capitol Ave., Hartford, Conn., is of the straight-line-frequency



type. The die-cast end plates insure mechanical rigidity, and the electrical characteristics are in keeping with its mechanical construction.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1671.

RADIO PLUG

The "Semi-Automatic" Radio Plug shown was submitted by Hart and Hegeman Co., 342 Capitol Ave., Hartford, Conn. The phone or loud-speaker terminals are rigidly clamped into this plug by turning the small knob It is of the standard size and well made.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1672.

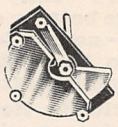
PANEL SWITCH

The Panel Tumbler Switch shown, submitted by Hart and Hegeman Co., 342 Capitol Ave., Hartford, Conn., is well constructed and reliable. It is equipped with an "on" and "off" name plate and is primarily designed for use as a filament switch.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1673.

SMALL CONDENSER

The "Microtuner" shown, submitted by Hart and Hegeman, 342 Capitol Ave., Hartford, Conn., is simply a three-plate variable condenser of the



type usually connected in parallel with the main tuning condenser for obtaining a fine adjustment. It may be used in other positions in the circuit, such as for balancing.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1675.

BATTERY TESTER

The "Break Not" Battery Tester shown, submitted by E. Edelmann & Co., 2362 Logan Blvd.,

Chicago, Ill., is well protected from injury by virtue of the generous amount of rubber used in its construction. The readings are accurate and plainly visible.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1681.

GASMOSPHERICS

Broadcast messages from Henry Ford have been heard in England. Unfortunately this is not the only audible evidence they receive of his existence.

REACTIVATION MADE EASY

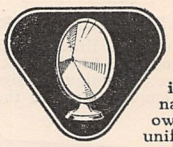
Our foreign correspondent informs us that now one need not despair over burnt-out vacuum tubes. "If thrown into the air," he says, "they will most assuredly light on the floor."

WHAT YOU GET BY JUST TURNING THE DIALS

I sigh for you, dear heart . . . So's your old man . . . Why did I kiss that girl . . . Let me call you sweetheart . . . At three o'clock in the morning.—*D. F. Kirby.*

Building Your Own 3 Foot Cone?

—choose cone material carefully



THERE is just one product made especially for the cones of cone type speakers—Alhambra FON-O-TEX. It is used by practically all the leading cone speaker manufacturers, because it produces tone quality far superior to papers or other substitutes for Alhambra FON-O-TEX.

This remarkable product has practically no grain; therefore it has no resonance point of its own, but resonates uniformly at all frequencies.

Price 75c for a sheet 38 x 38 inches—large enough for a 3 foot cone. Ask your dealer. If he hasn't Alhambra FON-O-TEX we will supply you. To the cost of the number of sheets you need add $1.00 for packing, f. o. b., N. Y. C.

The SEYMOUR Co., Desk 50
325 West 16th Street
New York City

ALHAMBRA FONOTEX
PRODUCT AND PROCESS PATENTED
FOR CONE TYPE LOUD SPEAKERS

You Build This Giant 3-Foot Cone Speaker

The Sensation of Radio

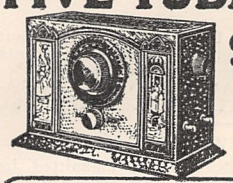
Only with a 3-foot cone speaker can you get **real tone** quality. Build your unit with care. Insist on a

Penn
Cone Speaker Unit

At your dealer, or send $14.15 for complete kit. Save 80% of cost at retail. Booklet "How to Build a 3-foot Cone Speaker" for 10c.

PENN RADIO SALES CO.
104 Fifth Ave. Suite 2009 New York City
Exclusive distributors for G. R. Penn Mfg. Co.

FIVE TUBE RADIO $25.00



AGENTS WANTED BIG COMMISSION

Demonstrating agent wanted; every county. Exclusive to right man. Sell what public wants—five tube, long distance, loud speaker radio with single dial control. Price within reach of all, $25.00 retail; liberal discount to agents. Sell in spare time—evenings. No selling or radio experience necessary. Territory going fast. 100 page Radio Book FREE. Write today—don't delay.

CC FISCHER, 122 W. Austin Ave., Chicago

American RADIO Now— Lowest Wholesale Prices on **RADIO!**

AMERICAN AUTO & RADIO MFG. CO.

BIG NEW 1927 CATALOG-FREE

Dealers, Agents, Set Builders—get our big 1927 Catalog—225 nationally advertised lines. Low money-saving prices! Largest, most complete stock. Radio's latest developments. It's FREE—send for your copy now.

AMERICAN AUTO & RADIO MFG. CO., Inc.
1433 McGee Street, Kansas City, Mo.

BIG CHRISTMAS SUBSCRIPTION OFFER

See Page 772 In This Issue

Radio News of the Month

(*Continued from page 628*)

AUTOMATIC BROADCAST INDICATORS

WITH the readjustment of European wavelengths to relieve the congestion of broadcast stations under the new Geneva agreement, about to go into effect, it is announced that all transmitters will be equipped with calibrated indicators which will automatically give a luminous signal if they vary from the assigned fundamental wave. Much interest in the working of the scheme is expressed abroad, as the waves of some stations have been very broad.

RADIO AMATEURS IN THE STORM BELT

THE story of the Lion and the Mouse found another application after the terrific Gulf storm which worked so much havoc in Florida. The aerial equipment of broadcast and commercial stations was wrecked by the unprecedented fury of the gale. In this emergency, the short-wave sets of local amateurs proved life-savers. The first station heard out of Miami was that of J. Y. Heisch, 4KJ, which "raised" 4HZ of Jacksonville and restored communication.

RADIO FOR SHIP DIRECTION

THE liner "Carnarvon Castle," just built at Belfast, Ireland, carries a complete radio loud-speaker system which will reproduce broadcast programs on her decks for the passengers. The same amplifiers will also be used in the operation of the ship, particularly when she is docking. Microphones are mounted on the bridge, so that the captain can issue orders to his crew without relying on the old fashioned speaking-trumpet.

ANOTHER RADIO GOLD STAR

CHARLES CLAVIER, radio operator, died at his post in the Sikorsky plane S-35, which was destroyed at Roosevelt Field, L. I., during the take-off for the attempted New York-Paris flight on the morning of September 21. He had been for eight years engaged in flight radio work, and his reputation for skill as well as good fortune was high. The ill-starred expedition was pictured in RADIO NEWS for October, together with its radio equipment.

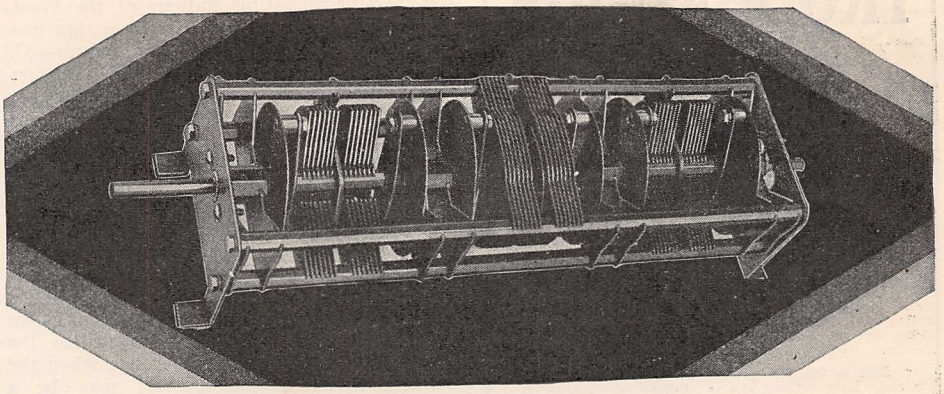
NO LICENSES, NO PROGRAMS

IN the United States, fortunately, there has yet been no need to pass the hat among radio fans, but elsewhere it is different. In New Zealand, for instance, "radio pirates" who are targets for numerous brickbats are people who are not paying for receiving licenses. At a recent meeting a government official criticised them sharply, saying that the postmaster-general, who is the regulating authority, cannot insist on stations beginning programs until fees have been collected to make the effort worth while.

TELEVISION TRANSMISSION LICENSED

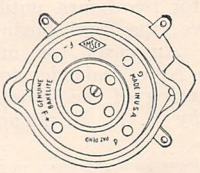
THE first television transmission licenses have been issued by the British Post Office to J. L. Baird, inventor of the Televisor, described recently in RADIO NEWS, for operation in London. The apparatus transmits on a wavelength of 200 meters, under the call letters 2LV. Listeners who tune in to

AMSCO
ALLOCATING
CONDENSERS

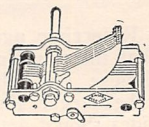


THE HEART OF THE
INFRA-DYNE

EACH unit of this AMSCO triple is .00035 micro-farads capacity, matched within less than 1%. They allocate or "spread" the stations with engineering precision—their uniformity making practical the hitherto theoretical ideal of Simplified Control. Construction guaranteed mechanically and electrically perfect. Approved by E. M. Sargent. At dealers.

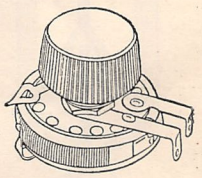


AMSCO FLOATING SOCKETS eliminate noises, mechanical feed-back and audio vibration. Approved by E. M. Sargent.



AMSCO ALLOCATING CONDENSERS. You'll need one of these single .00035 mfd. Allocators for your Infra-Dyne. Approved by E. M. Sargent.

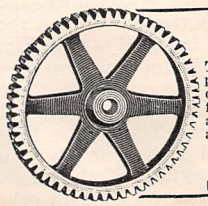
AMSCO METALOID GRID GATES. Approved by Sargent. Uniquely silent, due to new colloidal Metaloid resistance element.



AMSCO TOM THUMB RHEOSTATS save space front and back of the panel. Order a 10 ohm and two 30 ohm Tom Thumbs for your Infra-Dyne.

AMSCO PRODUCTS, INC.
Broome & Lafayette Streets, N. Y. C.

AMSCO
MEMBER RMA



GEARS
All Kinds—Small
The most accurate made and prices reasonable. We carry a complete line of gears in stock for immediate shipment. Can also quote on special gears of all kinds. Send us your inquiries.
Write for Catalogue 40
Chicago Stock Gear Works
105 South Jefferson St., Chicago

A Complete Line of Radio Power Units
From the Webster line of power supply units everyone may find the right type for his set at a price he can afford. "Little Giant B C"—at $50.00—has five variable voltages—one for C power. "Super B" has three voltages with variable control—price $39.00. "Popular B" is open type—$35.00—all equipped with Webster Duo Choke (pat. pending) and Raytheon tube. Write for complete description in folder "Improving Your Radio."
THE WEBSTER CO., 3516 West Lake St., Chicago

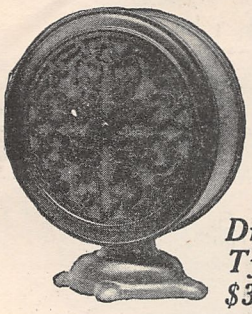
A Laboratory Product

CRESCENT LAVITE RESISTANCES
For Distortionless Amplification
Used on the U. S. A. Dirigibles. Made all capacities 12,000 ohms and up. List price $1.50. Special sizes to order. Write today. Discounts to dealers.
Crescent Radio Supply Co., 1-5 Liberty St., Jamaica, N. Y.

FREE RADIO GUIDE
164-PAGE (1927) GUIDE
LATEST HOOK-UPS
Gives special hook-ups with illustrations. Shows big savings on standard radio parts, complete sets, kits. Be sure to get this thrifty book before you buy. Write letter or postal NOW. Also include name of another fan.
BARAWIK CO., 542B Monroe St., CHICAGO, U. S. A.

Quali-Tone

TROUBADOUR

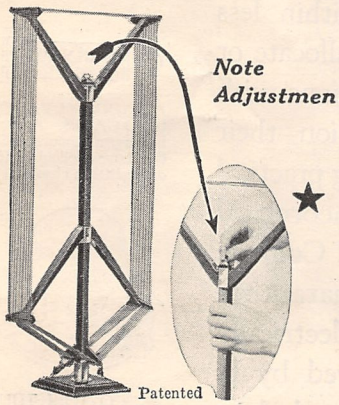


Drum Type $30.00

Just as the amorous nobles of old Spain, France and Italy enraptured a continent with their hauntingly beautiful music and poetry . . . so has the marvelous reproduction of THE TROUBADOUR impressed itself upon the Radio World of to-day.

It is Music and Song and Poetry unaltered, undistorted . . . true. Distinctively artistic in design, body finished in rich walnut brown, base and faces in dull black Morocco leather finish. Troubadoure's weight of 11 pounds is absolute assurance against vibration, while Quali-Tone construction along advanced lines results in a new quality of reproduction that amazes listeners by its depth, resonance and purity. Height 16¼". Diameter 13½". Depth 5½".

Send for literature on Quali-Tone's complete line, which includes Junior Speaker $7.50, Quali-Tone No. 2 Speaker $10, Quali-Tone No. 3 Speaker $15, Quali-Tone No. 4 Speaker $25, Quali-Tone Radio Units $6 and $7.50.



Note Adjustment!

Patented

8000 MILE RECORD

The Quali-Tone Loop pictured above holds two World's Records for distant reception, having brought in stations 8000 miles away. Write for verification of these records. Exclusive Thumbscrew Adjustment keeps wires taut always. Guaranteed to improve the performance of any receiver. Price $10

DEALERS—Write for discounts—JOBBERS
Send for circulars

DURO METAL PRODUCTS CO.
2651 N. Kildare Ave. Chicago

World's Finest Loud Speaker

A three-foot cone speaker—unit developed by the inventor of the Tropadyne. Easily assembled, saving 80% of the cost. Complete kit with blue prints sold on rigid money-back guarantee—shipped prepaid or C.O.D.—$10.

Engineers' Service Company
25 Church Street,
New York, N. Y.

FREE RADIO GUIDE

164-PAGE (1927) GUIDE

LATEST HOOK-UPS

Gives special hook-ups with illustrations. Shows big savings on standard radio parts, complete sets, kits. Be sure to get this thrifty book before you buy. Write letter or postal NOW. Also include name of another fan.

BARAWIK CO., 542B Monroe St., CHICAGO, U. S. A.

this wave hear a noise like the drone of a passing aeroplane. Transmissions have been made frequently to Harrow, a distance of about eight miles.

TWO STATIONS ON SAME CHANNEL

WBZ at Springfield and WBZA at Boston, two broadcasting stations of the Westinghouse Electric & Mfg. Company, are now operating on the same wave-length—333 meters or 900 kc., but as they are controlled by a single quartz crystal they do not interfere with each other. Both these stations of course are transmitting the same program, else the scheme could not be followed. The shift was made recently when WBZA gave up its 241.8 meter channel and adopted the same wave-length utilized by the older station at Springfield. Although this plan is unique in broadcasting, it is believed of exceptional interest since it permits two stations, although not at great distances from each other, to utilize the same channel without interference when the same program is carried. It may be a fore-runner of handling broadcasts from several stations on a single channel and thus save using several individual wavelengths.

HAMS HAVE ALL KINDS OF TIME

When Everett Gibbs, owner of amateur station 1AAC (at Framingham, Mass.) started operating a few evenings ago, he heard the calls of two other amateurs, a Mr. Mayer in England and another "ham" in New Zealand. A three-cornered conversation was carried on for two hours, until the operators had to leave: the Englishman for his day's work, the American for much-needed sleep and the New Zealander to eat his supper, in the evening of the same day.

—*Reported by P. B. De Yonge.*

The Loud-Speaking Christmas Tree

(*Continued from page 632*)

no further attention. Referring again to Fig. 3, it will be seen that the sounding box is equipped with two holes; (1) which is made in the top must be larger than the Christmas tree and its sides should not touch the latter. If it does, the vibrations of the veneer board will be checked, and the volume will not be anywhere nearly as good. The second hole (2) is in the removable board, and should fit tightly the stem of the tree. Three angle boards are then attached to the board (C) and the construction of this can be seen in Fig. 1. These angle boards surround the tree closely and hold it firmly in position. This gives a steady support, and with the large base of the box, eighteen inches square, there will be no danger of the tree toppling over.

In order to assemble the contrivance, the tree is first laid down horizontally upon the floor, after which the box (B)—see Fig. 3—is pushed over the bottom part of the tree. Then the board (C), with its three blocks to hold the tree, is put into place, and screwed down to the box. The tree is then ready and will be found to hold firmly. In order not to mar the surface of the table, the bottom of the box is provided with rubber cushions, which can be bought at any hardware store. The box itself may be painted or polished or decorated to suit individual tastes; its finished appearance is shown in Fig. 2. A hard-rubber composition bushing, which may be secured from any electrical supply store, is screwed into one of the sides, as shown in Fig. 2, to let out the loud-speaker cord and to finish off the assembly nicely.

It goes without saying that, before right-

DESIGNED to OUTLAST
World
Storage "A" Battery

Two-Year Guarantee Bond in Writing

NEW LOW PRICES

Famous the world over for reliable, enduring performance. Solid Rubber Case lasting protection against acid or leakage.

Approved and Listed as Standard by Leading Authorities

including Radio News Laboratories, Popular Sci. Inst. Standards, Pop. Radio Laboratories, Radio Broadcast Laboratories, Radio in the Home and Lefax, Inc.

Send No Money

Just state number wanted and we will ship same day order is received, by express C.O.D. Pay expressman after examining batteries. 5% discount for cash with order. Remember, you save 50% on World Batteries—so send your order today.

WORLD BATTERY COMPANY
Dept. 10
1219 S. Wabash Ave., Chicago, Ill.

Solid Rubber Case Radio Batteries
6-Volt, 100-Amperes $10.00
6-Volt, 120-Amperes $12.00
6-Volt, 140-Amperes $13.00

Solid Rubber Case Auto Batteries
6 - Volt, 11 - Plate $10.00
6 - Volt, 13 - Plate $12.00
12 - Volt, 7 - Plate $14.50

Set your radio dial at 288.3 meters for the World Storage Battery Station WSBC. Variety—new talent—always interesting.
Jerry Sullivan, Dir. and Announcer "Chi-CAW-go"

KDKA WSBC WEAF KYW

Quality Radio Cabinets

BETTER HOMES CALL FOR BETTER RADIO CABINETS

You can save hundreds of dollars by installing your set in one of these Beautiful Cabinets.

MAKE $100 LOOK LIKE $1000

Write for new 1926-27 catalog

THE WIRTHMORE COMPANY
910 Wirthmore St., Rockford, Ill.

Have You Seen "MONEY MAKING" ?

The new magazine that tells of hundreds of ways to make EXTRA MONEY.

DON'T MISS IT

25c ON ALL NEWSSTANDS

The Consrad Co., Inc.
53 Park Place :: New York City

ing the tree, the loud-speaker unit should be tried to see if it gives the full sound; and after the speaker is once adjusted it can be left in this position. After the whole has been assembled and the tree placed on the table or floor, the radio set can then be turned on. The effect is very mysterious, particularly if the connecting cord is hidden. It will then seem as if the music comes directly from the tree. I shall be glad to hear from those who have constructed the loud-speaking Christmas tree.

A Universal All-Circuit Set

(*Continued from page 682*)

treme left, mount the two-gang condenser, C3, and at the other end of the panel, the single condenser, C4. On both sides of the switch are holes for mounting the jacks. The three-point jack, J, is fastened through the hole at the right, and the filament control jack, J1, through the other.

Then place the sub-panel with the edge that goes toward the panel furthest from you. Put on the binding posts, beginning at the left hand end, in the following order: "B Amp+"; B Det+"; "B Bat—"; "A Bat+"; "A Bat—"; "C Bat+"; "C Bat—." The next two holes carry the grid condenser below the sub-panel and the grid leak mounting clips above it. At the right are two more holes; the further takes the "Ant." binding post, and the one next to it, the "Gnd." post. Then mount the five sockets under the sub-panel, with their tops coming through the holes provided, and the white dots toward the panel.

Holes for mounting the audio transforms, T, behind the rheostats must next be located, and one transformer mounted with its secondary toward the right hand side of the sub-panel. The other is best mounted at right angles to it, with its secondary towards the panel. Holes are drilled in the sub-panel, one directly under the shaft of the two-gang condenser, one between the two audio transformers and one just behind the shaft of the single condenser, so that the radio-frequency transformers, L1, may be mounted under the sub-panel.

RECOMMENDATIONS

In following the wiring diagram, (Fig. 8), it will be noticed that all the filament leads on the radio-frequency coils, L1, are run to the negative side of the "A" battery. Therefore the grid leak is connected to the positive filament lead, instead of across the grid condenser as is customary. The pilot light is generally omitted in this hook-up, so the midget condenser may be mounted in the hole; but by drilling an additional hole 2 5/16 inches below the first hole, this light may be used. The midget condenser is connected across either segment of the two-gang condenser; the one to which it is attached should be adjusted so that when the blades of the other are completely in mesh, its blades are about 1/32-inch out.

A separate condenser must be used to tune the first coil, as various lengths of aerial change the setting of this dial to quite an extent. If you are using an exceptionally long antenna, and find that the set tunes broadly, connect a .00025-mf. fixed condenser between the aerial binding post and the aerial lead-in wire. This will afford greater selectivity. The 700-ohm resistances, R3, need be added only if the set shows undue tendencies to oscillate. In that case they should be connected in the grid leads of the second and third tubes from the left, the two radio amplifiers, as shown in the wiring diagram (Fig. 8). The filaments of these tubes are controlled by the 10-ohm rheostat, the detector by the 20-ohm one, and the

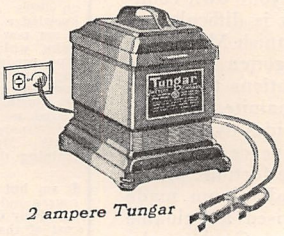
Send your good wishes
—and a Tungar, too

If he enjoys the radio—surprise him with a G-E Tungar. It will keep batteries fully charged; help him to obtain better reception. Through the years, its helpfulness will be a constant reminder of your greetings.

Five ampere, two ampere, or Trickle Charger—your dealer will show you the correct type for any service. They are all made by General Electric—they all can be permanently installed, and they all say "good-by battery charging problem."

P. S. Treat yourself to one, too.

East of the Rockies
2 ampere Tungar, $18
5 ampere Tungar, $28
Trickle Charger, $12
(60 cycles—110 volts)
Merchandise Department
General Electric Company
Bridgeport, Connecticut



2 ampere Tungar

Two ampere—charges all 2, 4 or 6 volt "A," and 24 to 96 volt "B" batteries in series—and auto batteries, too.
Trickle—charges 4 or 6 volt radio "A" storage batteries: four charging rates up to one-half ampere.
Five ampere—same range as two ampere but charges faster.

Tungar
REG. U.S. PAT. OFF.
BATTERY CHARGER

Tungar—a registered trademark—is found only on the genuine. Look for it on the name plate.

GENERAL ELECTRIC

Send For Your Copy Of Andrew's Radio Directory and Log

RADIO LISTENER'S RED BOOK

Gives new stations and latest changes.
Helps tune in stations never before heard.
Helps locate unlogged stations on your dials.
Shows broadcast and time division map.
Gives trouble information and remedies.
Lists stations in U. S., Can., Mex., Cuba.
Stations listed three different ways, by meters and kilocycles, by call-letters, by location.
Each list cross-indexed (copyrighted) with other two. 28 pages, well printed, heavy white paper.
If not sold by your local radio or news dealer, copy mailed postpaid for 25c each, coin or stamps.
THE WAYNE-ANDREWS CO., INC.,
1203 Central Bldg. Ft. Wayne, Ind.

LOETAN
QUICK LIQUID SOLDER

Requires no flux or excessive heat. Can be used with or without soldering iron.
Marvelous new German Invention. Solders metals of all kinds including iron, steel and precious metals. Indispensable for the set builder.
On sale at all radio stores or send $1.00 for special introductory offer of 3 cans.
Dealers Write for Discounts.
GLOBE IMPORT-EXPORT CO.
Dept. RN-5465 Everett Avenue
Fairfax 6713 Chicago, Ill.

Insure your copy reaching you each month. Subscribe to Radio News—
$2.50 a year. Experimenter Publishing Co., 53 Park Place, N. Y. C.

Chemistry paves the road to Success!

Some people measure success in terms of money and others in degree of knowledge and culture. Chemistry is the one uncrowded profession today that offers both. America, always a land of amazing opportunities, is especially so now in the field of applied Chemistry. Industries have developed within eight years more rapidly than the output of trained men to conduct them. Every big industry needs chemists and there is a real demand for them immediately.

Earn a Bigger Salary from now on—

Good Chemists Command High Salaries; you can make yourself independent for life by unearthing one of Chemistry's undiscovered secrets!

Do you remember how the tales of pirate gold used to fire your imagination and make you want to sail the uncharted seas in search of treasure and adventure? And then you would regret that such things were no longer done. But that is a mistake. They *are* done—today and every day—not on desert islands, but in the chemical laboratories throughout your own country. Quietly, systematically, the chemist works. His work is difficult, but more adventurous than the blood-curdling deeds of the Spanish Main. Instead of meeting an early and violent death on some forgotten shore, he gathers wealth and honor through his invaluable contributions to human ity. Alfred Nobel, the Swedish chemist who invented dynamite, made so many millions that the income alone from his bequests provides five $40,000 prizes every year for the advancement of science and peace. Herman Frasch, who showed how to extract sulphur built up a huge fortune. C. M. Hall, the chemist who discovered how to manufacture aluminum made millions through this discovery. F. G. Cottrell, who devised a valuable process for recovering the waste from the flue gases, James Gayley, who showed how to save enormous losses in steel manufacture, L. H. Baekeland, who invented Bakelite—these are only a few of the men to whom fortunes have come through their chemical achievements.

NOW IS THE TIME TO STUDY CHEMISRTY

Not only are there boundless opportunities for amassing wealth in Chemistry, but the profession affords congenial employment at good salaries to hundreds of thousands who merely follow out its present applications. These applications are innumerable, touching intimately every business and every product in the world. The work of the chemist can hardly be called work at all. It is the keenest and most enjoyable kind of pleasure. The days in a chemical laboratory are filled with thrilling and delightful experimentation, with the alluring prospect of a discovery that may spell Fortune always at hand to spur your enthusiasm.

YOU CAN LEARN AT HOME

To qualify for this remarkable calling requires elaborate specialized training. Formerly it was necessary to attend a university for several years to acquire that training, but thanks to our highly perfected and thorough system of instruction, you can now stay at home, keep your position, and let us educate you in Chemistry during your spare time. Even with only common schooling you can take our course and equip yourself for immediate practical work in a chemical laboratory.

EASY MONTHLY PAYMENTS

You don't have to have even the small price of the course to start. You can pay for it in small monthly amounts—so small that you won't feel them. The cost of our course is very low, and includes everything, even the chemistry outfit—there are no extras to buy with our course. Our plan of monthly payments places a chemical education within the reach of everyone.

SPECIAL 30 DAY OFFER

Besides furnishing the student with his Experimental Equipment, we are making an additional special offer for a short while only. You owe it to yourself to find out about it. Write today for full information and free book "Opportunities for Chemists." Send the coupon right now while it is fresh in your mind. Or just write your name and address on a postal and mail it to us. But whatever you do, act today before this offer is withdrawn.

DON'T WAIT—MAIL COUPON NOW!

CHEMICAL INSTITUTE OF NEW YORK, Inc.
Home Extension Division 12
66-R West Broadway **New York City**

LETTERS
From Students Who Have Taken This Course

You will probably be pleased to learn one of the lessons gave me an idea to turn my chemical knowledge to profitable account. I am now making a varnish and paint which undersells the other type products by $2.60 a gallon, in some cases more. Have been receiving gallon orders from painters during past week which has netted me a profit of $12.50 for my "spare-time chemical industry." Many thanks for your training thus far.

J. J. KELLY.

I am but half way through your course and am certain that I have saved my Company many times the cost of the course and raised myself in the Share Holders estimation. The knowledge obtained has its immediate practical application and I do not hesitate in saying your course and the personal attention you give is invaluable to the practical man in any business where chemistry plays a part. You may use this letter and my name and address to the furtherance of your good work.

JOHN WALTER.

I have not written since I received the big set. I can still say that it far exceeded my anticipations. Since I have been studying with your school I have been appointed chemist for the Scranton Coal Co., testing all the coal and ash by proximate analysis. The lessons are helping me wonderfully, and the interesting way in which they are written makes me wait patiently for each lesson.

MORLAIS COUZENS.

T. O'CONOR SLOANE, A.B., A.M., LL.D., Ph.D.

Noted Instructor, Lecturer and Author. Formerly Treasurer American Chemical Society and a practical chemist with many well known achievements to his credit. Not only has Dr. Sloane taught chemistry for years but he was for many years engaged in commercial chemistry work.

EXPERIMENTAL EQUIPMENT FURNISHED TO EVERY STUDENT

We give to every student without additional charge this chemical equipment, including forty-nine pieces of laboratory apparatus and supplies, and forty different chemicals and reagents. These comprise the apparatus and chemicals used for the experimental work of the course. The fitted heavy wooden box serves not only as a case for the outfit but also as a useful laboratory accessory for performing countless experiments.

CHEMICAL INSTITUTE OF NEW YORK, INC.
Home Extension Division 12
66-R—West Broadway, New York City

Please send me at once, without any obligation on my part, your free Book "Opportunities for Chemists," and full particulars about the Experimental Equipment given to every student. Also please tell me about your plan of payment and your special 30 day offer.

NAME .....

ADDRESS .....

CITY ..... STATE.....

R.N.Dec. 1926.

audio tubes, by the automatic filament controls, R4.

While we have presupposed the use of ready-drilled panel and sub-panel in this article, (in connection with the parts listed in the first column of manufacturers—see list of parts) it is also possible to build the same sets with other parts; but it is advisable in this case to use a 24-inch panel for the five-tube set. The parts will probably take up more room, because the design may not be so carefully worked out for compactness combined with efficiency. Nevertheless, the diagrams and general placement of apparatus as given here will be satisfactory for use with any combination of standard parts, provided they are of good quality.

The Main Problems of Television

By DR. WALTER FRIEDEL

IF we wish to transmit a picture over a great distance, or if we wish to observe events transpiring in some remote locality, we find that common optical expedients will not suffice; for the simple reason that the earth is round. Ergo, instead of relying on light we must resort to another medium, viz., electricity. Unfortunately, we cannot transmit a whole picture simultaneously by electricity, as we can when employing light as the carrier; we are forced to project a piece of it at a time through space, and reconstruct it at the receiving end. Actually, when employing electricity, we send our pictures a dot at a time, each dot having the original shading or intensity that it had in the original. This fundamental requirement exists also for television apparatus, which transmits not only the dots, but also whole pictures, at such a speed that their repetition at the receiving end gives to the eye the impression of motion.

Every picture-transmitting machine or television machine contains a device for analyzing the picture into dots, and a device for the conversion of the variations of the light of the single picture-dots into electrical oscillations. The receiver consists of apparatus for the re-conversion of the electrical vibrations into light variations, and a device for the synthesis or reconstruction of the pictures. Further, a device is always required for maintaining synchronism between the transmitter and the receiver. Without this the picture at the receiving end would be unintelligible.

PICTORIAL TRANSMISSION

The transmitting apparatus shown in Fig. 1 is similar to the well-known system of picture telegraphy in use at the present time throughout most of the world. Its functioning is not very complicated; the rays emitted by the source of light (*) are concen

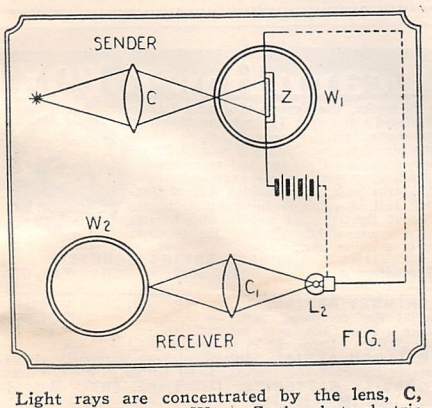
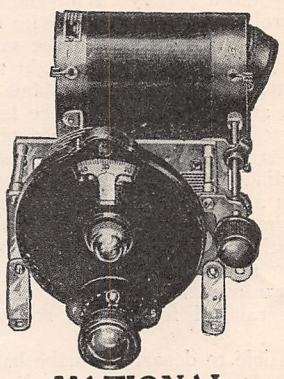


FIG. 1

Light rays are concentrated by the lens, C, through the film on W1 to Z, the photo-electric cell. This controls the light, L2, which registers the same picture on W2.

NATIONAL
RADIO PRODUCTS

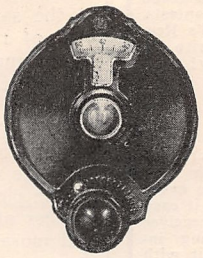


NATIONAL
Tuning—Units

The NATIONAL Tuning units combine the wonderful BROWNING-DRAKE spacewound coils and R.F. Transformers, the NATIONAL "EQUICYCLE" or "EQUIMETER" Condensers and the NATIONAL VELVET-VERNIER Dials, with their unexcelled smoothness and durability of action. They may now be secured equipped with a new NATIONAL ILLUMINATED Type C Dial which is readily installed without any special tools, or the cutting of irregular holes, and forever solves the problem of careful logging of stations when the set is in a dark corner of the room.

With these NATIONAL Tuning Units, a set of NATIONAL IMPEDAFORMERS and the necessary panels, sockets, rheostat and wiring, you can construct a modern Radio receiving set—easy to make, easy to look at and easy to listen to.

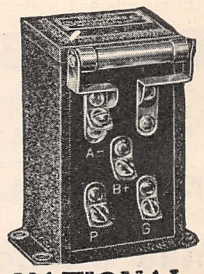
Price — NATIONAL Tuning Units, $9.75 to $14.75, dependent upon the combination. Be sure to get the genuine NATIONAL products.



NATIONAL
THE ILLUMINATED DIAL—Velvet-Vernier Type C

The scale of this dial is brilliantly lighted by a tiny concealed 6-volt lamp, which is either connected to the filament wiring—acting as a tell-tale, or may be separately switched. It is easily attached by anyone without special tools of any kind and does not require cutting of irregular holes. It has every feature which has made the NATIONAL VELVET-VERNIER A and B dials so universally used, variable ratio of from 6-1 to 20-1, the rugged Bakelite case, which always retains its fine appearance, and the velvety action which never wears loose.

This Dial Makes Logging of Stations Easy In the Darkest Corner of Your Living Room.



NATIONAL
Impedaformers

The NATIONAL IMPEDAFORMERS are made to place good audio amplification within the reach of every set owner. It is often the case that a Radio set will do everything that can be asked of it as regards distance. But its audio amplifier is not up-to-date and compares unfavorably with the present-day standards of truthfulness of reproduction. The IMPEDAFORMERS have been made for sets of this kind and of course for the construction of new sets. There are three Impedaformers to a set, each containing a high inductance choke, a LYNCH Resistor and a TOBE Coupling Condenser. The first stage unit contains also a Radio-frequency choke, without which audio-amplification is like meat without salt.

RECIPE FOR GOOD AUDIO.

To a set of three Impedaformers, add three sockets, a rheostat and the necessary wire and binding posts. Very little time or skill is required for the production of a modern IMPEDANCE-COUPLED Amplifier. PRICE $5.50 EACH

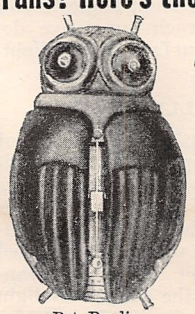
NATIONAL Radio set essentials may be easily assembled into a modern receiving set,—sensitive, selective, easy to operate and easy to listen to. Be sure you get genuine NATIONAL products.

Send for Bulletin 116 R.N.

NATIONAL COMPANY INCORPORATED, 110 Brookline Street, Cambridge, Mass
Engineers and Manufacturers
W. A. READY, President

MAKE SURE IT IS MADE BY
NATIONAL

Fans! Here's the Latest Novelties!



Good Crystal Sets in beautiful Art Pottery.

THE BUG
9 in. long—The Real Thing.

Rolling Pin
15 in. long—Rolls 'Em In

Wall Pocket
11 in. long—Pat. Sept. 14, '26

Nothing like them—Ask your dealer or send to us—You'll be surprised and delighted—Retail Price $7.50 each. Dealers—Samples prepaid $5.

Pat. Pending
BRUSH POTTERY CO., Zanesville, O.

COILS Special GEN-RAL PARTS Regular
REGISTERED

WRITE For The Four Tube Hook-up With THE GEN-RAL TEAM

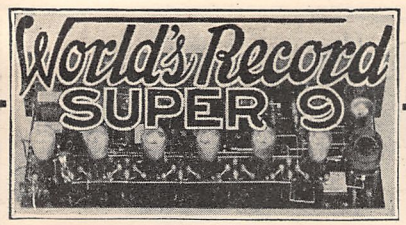
NEW DUO-FOMER Five Tub Circuit Is Ready NOW

A Special Message

GENERAL MANUFACTURING CO.
6637 So. Cottage Grove, Chicago

INVENTORS who derive largest profits know and heed certain simple but vital facts before applying for Patents. Our book Patent-Sense gives those facts; sent free. Write LACEY & LACEY, 631 F St., Washington, D. C. Established 1869.

UNION RADIO TIP JACKS and IDENTIFICATION TAGS
UNION RADIO CORPORATION, Newark, N. J.



Blue Prints

FREE Write for a complete description of the Peer of all receivers—the World's Record Super 9—the wonder receiver that holds 4 fully verified World's Records for distance. The World's Record Super 9 is one of the few receivers to bring London into Chicago during the last two International Contests. Thousands of testimonials hail the World's Record Super 9 as the marvel of Radio. Write for free list of records and testimonials today!

Easy to Build

You can build an exact duplicate of the original World's Record Super 9 by following our Blue Prints. Building instructions complete in every detail with each set of Blue Prints make it easy for anyone to build this remarkable receiver with perfect success. Complete Building instructions and Blue Prints $5.00. Remit with order or we will send C. O. D.

Mail the Coupon Today!

M-S SYNDICATE

Box 2131 **Cleveland, Ohio**

M-S SYNDICATE,
Box 2131, Cleveland, Ohio

☐ Please send me free literature and verifications of the records made by the World's Record Super 9.

☐ Am enclosing $5 for Blue Prints, etc.

☐ Send me Blue Prints, etc., C.O.D.

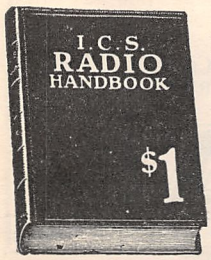
NAME .....

ADDRESS .....

.....

Every Radio Fan should have this book

JUST OUT—514 PAGES



Compiled by
HARRY F. DART, E.E.
Formerly with the Western Electric Co., and U. S. Army Instructor of Radio.
Technically edited by F. H. Doane

NO MORE need you turn from book to book, hoping to find what you want. It is all here, in 514 pages crammed full of every possible radio detail. Written in plain language, by engineers for laymen. 100,000 sold.

IT EXPLAINS: Electrical terms and circuits, antennas, batteries, generators and motors, electron (vacuum) tubes, many receiving hook-ups, radio and audio frequency amplification, broadcast and commercial transmitters and receivers, super-regeneration, codes, etc.

Send $1 today and get this 514-page I. C. S. Radio Handbook—the biggest value in radio today.

International Correspondence Schools
Box 8281-H Scranton, Penna.

I enclose One Dollar. Please send me—post-paid—the 514-page I. C. S. Radio Handbook. It is understood that if I am not entirely satisfied I may return this book within five days and you will refund my money.

Name.....

Address.....

Check here ☐ and enclose $1.50 if you wish the edition bound in Leatheroid.

EVERYTHING IN RADIO
AT ATTRACTIVE PRICES. SETS OR PARTS.
Prompt and Honest Service. Write for Prices.
Mail Order Only.
ALL RADIO COMPANY, 417 North Clark St., Chicago

trated on a small dot of a photographic film, stretched on a glass cylinder W1, bypassing them through the lens C. The light rays will be diminished in direct proportion to the shading of the spot on the film, and so shine on the selenium or photo-electric cell, Z, with varying intensity as the glass cylinder is rotated. This light-sensitive-cell, Z, is connected into a battery circuit and accordingly controls the flow of current to the light, L-2, at the receiving end, in the same degree that it is acted upon by the light ray at the transmitter. The light fluctuations of the lamp, L-2, are concentrated by the lens, C-1, and directed upon an undeveloped photograph film stretched upon the cylinder, W-2. The cylinders, W-1 and W-2, rotate in synchronism and thus displace themselves at the same time in the direction of their axis of revolution. It is clear that all the dots composing the original picture will be successively transmitted and finally registered on the sensitized film at the receiver end.

It is not possible to depart from the basic principle outlined; it is necessary to break up the picture to be transmitted into a great number of dots and reconstruct it into a virtual mosaic at the receiving end. However, there are two ways in which this can be accomplished; either by the use of a great number of light-sensitive cells in the transmitter and likewise a great number of telegraphic lines, or by a single line and one light-sensitive cell, as commonly employed, upon which all the parts of the picture are successively projected. By the first method all the dots of the picture are transmitted at the same time; in the second they are transmitted, one after the other, at such a great speed, that the eye receives the impression that the actions are simultaneous.

Upon first thought it might seem that the "many-cell method" would be the most satisfactory, but it is very difficult to carry into practice. To produce a simple picture, at least 10,000 dots must be transmitted; while more complicated pictures, such as groups of people or a landscape, demand the transmission of from 60,000 to 80,000 dots. Imagine that many light-sensitive cells! Another fact that makes the many-celled method impractical is the requirement of multiple lines or, if we are to substitute radio, multiple wavelengths.

It is obvious then, that the one-cell method is the most practical. This system, as developed by Denes von Mihaly, is illustrated in Fig. 2. The original picture to be transmitted is projected by the objective, O, on the condenser lens, C. This lens concentrates the beams of light on a small oscillating mirror, Sn, which in turn throws them on the screen, S. This screen has a small opening, B, behind which is mounted a light-sensitive cell, Se. The mirror, Sn, actually consists of a series of small reflectors mounted on the rim of a wheel, which oscillates rapidly in one direction, and at the same time, slowly on an axis at right angles to the first. In this manner each successive dot is projected across the surface of the light-sensitive cell.

SUFFICIENCY OF ILLUMINATION

The one-cell method of television is, of course, considerably cheaper than the multi-cell arrangement and has proven itself more adaptable to conditions. However, there is one great disadvantage which, in the opinion of the writer, has up until now hindered the progress in television. This disadvantage lies in the fact that the amount of light falling on a single dot is insufficient for really satisfactory operation of the arrangement. As an example; the objective of the television apparatus may be a photographic lens projecting images of great intensity of light, say four inches square. If we are satisfied with an area 1/25-inch square for

QUALITY **DONGAN** **PRODUCTS**

Transformers and Chokes

used in

Lynch Power Amplifier

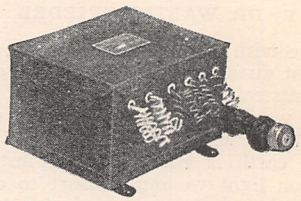
with the

Browning-Drake Receiver

consists of

1—No. 2561 Transformer list $8.00
2—No. 1591 Chokes list $6.00

Dongan Parts are an important factor in the marvelous performance of the Lynch Power Amplifier. Like all Dongan products these power units are sturdy and dependable and are guaranteed to give satisfaction. No. 2568, a combination of No. 2561 and No. 1591, also is ideal in the construction of A B C Eliminators using the Raytheon B H tube.



Regardless of what type of eliminator or power amplifier you build you will get certain success with the proper Dongan Parts. Two popular types are No. 2505 and No. 2569 transformers for RCA No. 213 and No. 216 B tubes used in connection with A B C and Power Amplifier circuit.

Send for complete information on types you are interested in.

Dongan Electric Manufacturing Co.
2977-3001 Franklin St., Detroit

TRANSFORMERS of MERIT for FIFTEEN YEARS

RADIO DEALERS

Get the New 1926-27 Van-Ashe Catalogue—

Shows all the newest parts, circuits and kits—all the hard-to-get items that set-builders demand. 12-hour shipments — extra-good discounts. Mail the coupon.

Van-Ashe Radio Co.
210 North 10th ST. ST. LOUIS, MO.

Send catalogue.

Name .....

Address .....

Learn How to BOX

In 20 weeks, the System of Jimmy DeForest World's Greatest Trainer and Maker of Champions, teaches you all there is to learn about boxing. Every 6 months 30 are selected from all classes and recommended to leading promoters for engagements. Send for famous book, **"The Golden Age of Boxing,"** full of valuable information, photos of great fighters and pupils who became successes overnight. Enclose 10c to cover cost of mailing, etc.

JIMMY DeFOREST BOXING COURSE
347 Madison Avenue, Box 3912, New York City

CHIMNEY AERIAL. 100-ft. cage coil, heavy gauge and special fire resisting, very sensitive in conjunction with smoke column and cage construction, most selective, low atmospherics. Price, $3.50 (pstge., 6 lbs.)

BALLOON AERIAL. Initial pick-up extremely strong, suitable for week-end tryouts, $5.00 (pstge, 5 lbs.), extras.

GRAVITY BATTERIES. Gallon size, $1.25. Runs ¼ amp. tube 1800-2400 hrs.

RIBBON WIRE. For honeycomb, pancake or other inductances. Equivalent to No. 24 round wire. Write for literature, samples; ¼ lb., $2.00; ½ lb., $3.50.

EVERETT SCANLON, Radio Specialties, Lakewood, R. I.

each dot of the picture, only one ten-thousandth part of the total light, which is already somewhat diminished after having passed the lens, would fall on a single dot of the picture.

However, we are not concerned with the loss of light intensity in the oscillograph mirror, but with the length of time the light can be thrown on a single dot. We know that in motion pictures it is necessary to make ten complete changes of pictures each second, in order to convey the actual motion to the eye of the observer. In television, not only is this necessary but we must, as well, transmit myriads of dots in a much less space of time to complete a single picture at the receiving end. Owing to this fact, the light, which is not of great intensity in the first place, influences the light-sensitive cell for only 1/100,000 of a second, the time taken for the transmission of a single dot. It can be readily appreciated that in such a short time the light cannot accomplish a great deal.

In the arrangement shown in Fig. 1 the whole light, radiated from a strong source of illumination, is concentrated on a single dot of a picture. Therefore the light quantity influencing the light-sensitive cell is much greater than it would be in a television machine. Also, the duration of influence is much longer, because it is not necessary that

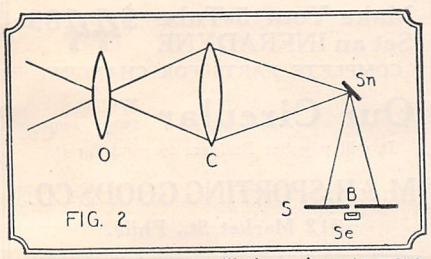


FIG. 2

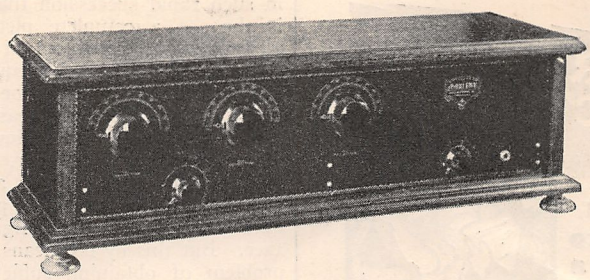
This system uses an oscillating mirror to make the image register on the sensitive cell.

the whole picture be transmitted in one-tenth of a second; many minutes can be taken if necessary. There is no particular hurry, so to speak, as no attempt is being made to reproduce motion.

DEVELOPMENT OF APPARATUS

It must be said that today we have excellent apparatus at our disposal which is particularly adaptable to television systems. The photo-electric cell is one such device; it operates practically without inertia; and there are excellent devices for the reproduction of the shading of the picture at the receiving end. At the present time it is not at all difficult to transmit the high-frequency vibrations of the current, corresponding with the variations of light, by impressing them on a carrier wave such as that employed for broadcasting. It is also comparatively simple, nowadays, to maintain perfect synchronism between transmitter and receiver, which heretofore was quite a problem. But we have not yet struck on a device that will furnish us sufficient light intensity for each dot in the stupendous series that must be transmitted in one second to attain motion pictures. This remains a problem.

We encounter a somewhat similar dilemma in the receiving apparatus; the influence of the light impression of each single dot has a duration of only 1/100,000 of a second, the same as at the transmitter, yet must make a suitable impression on the eye of the observer. The moving picture obtained in television differs in principle from the usual motion picture, as in the latter *all* dots of a single picture are observed by the eye simultaneously and have a duration of one-tenth of a second. On the other hand, in a television motion picture the eye of the observer sees but one dot at a time; but they appear



Make Big Money from Radio with this Phenomenal Set

No Investment

Here is an opportunity for every battery man to get into the radio business without investment in sets or parts, with the most phenomenally successful radio set ever built. The performance of this radio set has stampeded thousands of people to dealers' stores. In operation in Chicago one block from KYW's powerful station, the turn of half a point on the dial eliminates this station and brings in distant points—so selective is this extraordinary set. It is the equal of any set on the market selling from $115.00 to $150.00. Yet you sell for $65.00 and make $25.25 on every sale.

The wonderful AMBU plan makes you a partner in this business without investment.

Worth $115.00
You Sell for $65.00
You make $25.25

TWO AMAZING NEW EXCLUSIVE FEATURES

The AMBU FIVE has two features not to be found in any other set. The subpanel is inlaid with copper that has been shot into prepared grooves so that complete assembly of set is simply a matter of screwing parts into place. Connections are automatic and everlasting. 105 points of contact, yet only 4 soldered connections.

The AMBU all-wave coils enable the operator to bring in any stations broadcasting on a wave length of from 40 to 600 meters. Ordinary sets do not go below 200 meters.

Hundreds of dealers in battery shops, tire shops, garages, phonograph shops, etc., are cleaning up big with the AMBU FIVE. Our plan enables you to sell radio without a big investment in stock. We carry the stock for you. You buy at jobber's prices and sell at a handsome profit.

AMBU RADIO INSTITUTE
2634 I Prairie Ave.
CHICAGO, ILLINOIS

FREE

Send the coupon below immediately for your free copy of the new AMBU plan by which hundreds of men are making from $100 to $200 a week—many just in spare time. This is the opportunity of a life time to hook up right on the ground floor with the set that promises to be the most popular 5-tube set on the American market. Mailing the coupon below will cost you but two cents. The offer it brings may bring with it a small fortune in radio. Get it in the mail today properly filled out.

Read

I got my set working this morning and have taken orders for 5 today. Please ship quick and send 5 more Saturday. The AMBU FIVE is a wow.
J. Manley.

Heard KDKA today on 58 meters. I am half a block from WGN and bring in out of town stations with the AMBU FIVE at all times without interference.
R. Peterson.

Ship 10 AMBU FIVE'S at once. The 2 I had were sold last night and I have many other customers who heard demonstrations and who want the set. AMBU FIVE is the greatest bargain in radio.
J. McNamara.

AMBU RADIO INSTITUTE
2634 I Prairie Avenue
CHICAGO, ILLINOIS.

Send me free, complete information and prices and tell me how I can make big money in radio as representative without investment in stock. This does not obligate me.

NAME.....
ADDRESS.....
CITY.....
STATE.....
BUSINESS.....
☐ Send Information on Radio Course

C. L. PARKER
Ex-Examiner U. S. Patent Office
Attorney-at-Law and Solicitor of Patents
McGill Building, Washington, D. C.
Patent, Trade Mark and Copyright Law

RADIO PANELS
OF GENUINE BAKELITE
Cut, drilled and engraved to order. Send rough sketch for estimate. Our New Catalog on Panels, Tubes and Rods—all of genuine Bakelite—mailed on request.
STARRETT MFG. CO.
520 S. GREEN ST. - - CHICAGO

DEALERS AND AGENTS
Write for exclusive Franchise on the well known line of Buckingham High Grade Radio Receivers.
Selected Franchise Dealers will receive a special introductory discount under our new plan.
BUCKINGHAM RADIO CORPORATION
25 East Austin Ave., Chicago, Ill.

FREE RADIO GUIDE
164-PAGE (1927) GUIDE
Gives special hook-ups with illustrations. Shows big savings on standard radio parts, complete sets, kits. Be sure to get this thrifty book before you buy. Write letter or postal NOW. Also include name of another fan.
BARAWIK CO., 542B Monroe St., CHICAGO, U. S. A.

Insure your copy reaching you each month. Subscribe to Radio News—$2.50 a year
Experimenter Publishing Co., 53 Park Place, N. Y. C.

FOUNDED 1899

LEARN ELECTRICITY IN 12 WEEKS

Earn $60 to $200 a Week!

FREE Railroad Fare!

Why work for $25.00 or $30.00 or even $40.00 a week when as a **Coyne Trained Expert** you can make $60.00 to $200.00 a week. *Coyne Trains You On Actual Electrical Machinery.* No books or lessons, all practical experience. You don't need education or experience. *We Will Assist You To Part Time Job While Learning And Free Employment Service For Life After Graduation.* Free courses in Radio and Auto Electricity and I'll pay your railroad fare. **Write Now for Free Book.**

COYNE ELECTRICAL SCHOOL 1300-1310 West Harrison St. CHICAGO, ILL. Dept. 96—87

Fill In And Mail To Day

H. C. Lewis, Pres.
Coyne Electrical School, Dept. 96—87
1300-1310 W. Harrison St., Chicago

Dear H. C.: Please send me free your big catalog and full particulars of your special offer.

Name _____

Address _____

Town _____ State _____

Choose with Confidence

World Radio Storage "B" Battery 12 Cell—24 Volt

2.75

Proved value. Thousands of users find reception almost magical. Clear, true power—instantly and unendingly. Wise economy. Sturdy construction—*Solid Rubber Case* protection. Recharged for almost nothing. Endorsed and listed as standard by famous Radio institutions including Pop. Radio Laboratories, Pop. Sci. Inst. Standards, Radio News Lab., Lefax, Inc., and other Radio authorities. What more need be said? *Extra Offer: 4 Batteries in series (96 volts) $10.50.*

Send No Money Just state number wanted and we will ship same day order is received, by express C. O. D. Pay expressman after examining batteries. 5% discount for cash with order. Remember—you save 50% on World Batteries.

WORLD BATTERY COMPANY

1219 So. Wabash Ave. Dept. 75 Chicago, Ill.

Makers of the Famous World Radio "A" Storage Battery
Prices: 6-volt, 100 Amp. $10.00; 120 Amp. $12.00; 140 Amp. $13.00.
All equipped with Solid Rubber Case.

Set your radio dials at 288.3 meters for the World Storage Battery Station WSBC. Variety-New Talent-Always Interesting; JERRY SULLIVAN—Director and Announcer—"Chi-CAW-go"!

Protect Your Set

BIRNBACH BATTERY CABLE

SIMPLIFIES THE CONNECTING OF RADIO BATTERIES

SEPARATE COLORED WIRES

5 Conductor Cable with Soldered Terminals 50¢

ALSO MADE IN 6-7-8-WIRE CABLES

Improve Your Reception

BY PLACING YOUR LOUD SPEAKER ANY DISTANCE FROM YOUR RECEIVER

20 ft. Extension Cord with Connector $1.00

AND 30-40-50-100-FOOT UNITS

SEND FOR FREE LITERATURE

BIRNBACH RADIO CO.

370 SEVENTH AVE. ~ NEW YORK CITY

FREE RADIO GUIDE

164-PAGE (1927) GUIDE

LATEST HOOK-UPS

Gives special hook-ups with illustrations. Shows big savings on standard radio parts, complete sets, kits. Be sure to get this thrifty book before you buy. Write letter or postal NOW. Also include name of another fan.

BARAWIK CO., 542B Monroe St., CHICAGO, U. S. A.

in such rapid succession that the impression is that of a complete picture. Korn has already called our attention to the fact that there is a limit to the frequency of impressions on the eye that can be registered satisfactorily, and for this reason believes that the one-cell method of television will never prove practical. However, it is possible to lengthen the duration of a single impression of light by using a projection screen having a phosphorescent light-receiving surface. But this by no means would solve the problem of obtaining sufficient light intensity for each dot transmitted.

All these observations go to show that objectives yielding an extremely large aperture must be employed in both the transmitter and receiver. If all dimensions are increased in proportion, the amount of light falling on a single dot will be increased. If the linear dimensions of the camera were to be increased tenfold, the light falling on a single dot of a picture would be 100 times greater. It is hard to say whether this would completely solve the problem, but there is little doubt that it would increase the effectiveness of operation.

GOVERNMENT AND THE RADIO

By BELLA WEBB

DURING the recent strike the radio won its way into the everyday life of the English people, as it could never do before. The service rendered by the government broadcast stations, in supplying hour-by-hour news of the historic event as it developed, convinced the entire British public of the value of radio in every home.

In reviewing the strike, one observer said: "Radio killed rumors, broke down the isolation threatened by restricted transport, and kept every listener in close touch with the steps that were being taken to maintain order and facilitate the distribution of supplies. That service has secured indirectly a two-fold reward: it has broken down permanently the prejudice against radio which many people hitherto displayed, and it has increased the business of the radio industry as a whole. Circumstances more favorable to a demonstration of the capabilities of radio could hardly be imagined."

In every national crisis there are thousands of people, who wonder if the news being given them has not been at least partly manufactured to meet the designs of interested parties. They cite means whereby events and the opinions of leaders could very easily be misstated. They are the pessimists found in every situation, and because there are always others over whom they have influence, their words have often postponed the successful close of many a worthy issue.

With the common use of the radio, however, the wind is quite taken from the sails of all such people. We get statements directly from the leaders themselves, as directly as if they were face to face with us. Important news comes from government officials, as personally as if they had come to call on us alone. There is no chance of any intermediary between them and us.

Much has been said about the influence the radio is having upon international relations today, but little has been made of the fact that it is one of the greatest factors in strengthening the faith of a people in their own particular government. As the sincerity of their officials penetrates an increasingly larger number of homes, there is bound to be less political unrest and criticism. And all these things are going to have a tremendous influence on the prosperity and happiness to be found in every civilized community.

M & H

ESTABLISHED 30 YEARS
RADIO'S LARGEST KIT SUPPLY HOUSE

SPECIAL
Kit Complete Parts
Famous Daven-Bass Note Receiver

Parts as Described and Used By Author $51

All Shipping Charges Prepaid.

The set that produces all the finest notes, low tones especially. Six tubes including resistance coupled amplification. D R F Coils. Wonderful Selectivity, Volume and Distance. Tubes, of course not included.

Make Your 5-Tube Set an INFRADYNE $44.85
COMPLETE PARTS FOR CHANGING

Our Circular Will be ready soon.
It will pay Set Builders to send for it.

M. & H. SPORTING GOODS CO.
512 Market St., Phila.

"B" BATTERY ELIMINATOR

Only $7.95

MONEY-BACK GUARANTEE

No more worry with "B" Batteries! Hook up a Roll-O "B" Battery Eliminator and forget battery troubles forever. This wonderful new invention means better reception, sharper tuning. Gives you more real pleasure from your set.

Completely Equipped—No "Extras" to Buy

Operates perfectly on direct or alternating current, giving up to 90 volts current, and using the full wave of the power supply. Simple directions enclosed—anyone can plug it in to any kind of set up to six tubes. Constant voltage gives set more power. Costs no more than set of good "B" Batteries. Solidly built in beautifully finished metal case, with genuine Bakelite top.

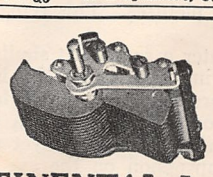
Send $1.00

SEND YOUR ORDER NOW

Don't blame your set because run down "B" Batteries won't let it work right. Order your Eliminator NOW. Write name and address on a piece of paper, pin a dollar bill to it, and mail it TODAY. Pay postman balance ($6.95 plus a few cents postage) when he delivers your Eliminator. Use it ten days. If not more than satisfied, return it and get your money back.

THE ROLL-O RADIO CO.
Dept. Q5 3d & Sycamore, Cincinnati, O.

Capacity .00035



PRICE $2.50

CONTINENTAL Lo Loss CONDENSERS

The low dielectric losses, exact capacities and mechanical perfection of Continental condensers make them the logical choice where fine reception is appreciated.

Continental (Single) .00035 ..... $2.50
Continental (Double) .00035 .... $5.00
(Specified in the Daven Bass Note Receiver)

If not at your dealer's, write Condenser Headquarters

GARDINER & HEPBURN, Inc.
611 Widener Bldg., Philadelphia

Radio Reception with Two Grounds

By H. A. EVEREST

EXPERIMENTS with all kinds of underground antennae have convinced the writer that two grounds, with a condenser in the circuit, gives best results. See Fig. 1.

This antenna system is slightly directional, though this cannot be detected on local stations. This directional effect may be due to the shielding action of the first ground on the second one. This theory is supported by the fact that, if the two grounds are over 75 feet apart, better results are secured by using two ground connections, ten feet apart, at the end nearest the station desired, as shown in Fig. 2.

However, 60-foot spacing gives fine results and is recommended to those wishing to experiment. For an ordinary wide city lot, three grounds, spaced in an equilateral triangle, give complete control of directional effects by using various combinations. See Fig. 3.

The size of the condenser in series with the system is not critical. A .0005-μf. variable condenser can be used, or the following fixed condensers can be tried; .005-, .00025- and .0001-μf., using the one which gives the desired selectivity.

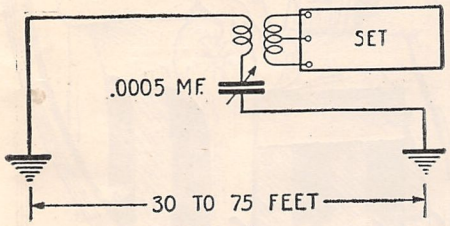


FIG. 1.

Instead of a wire-antenna system, two ground connections may be used as shown above.

INSTALLING THE SYSTEM

To test this method get two ¼-inch or larger rods 42 inches long (old solid brass curtain rods do very well). Solder or clamp a 60-foot length of No. 14 rubber-covered wire to each rod. Attach one end of a wire to the antenna post of your set through a condenser; and drive the rod in damp ground, trying different spacing and directions with your regular ground and with the two rods until you determine the best positions. Using a double-throw, single-pole switch, you can make quick comparisons with a regular aerial.

After the best spacing and directions have been determined, the rods should be replaced with a good permanent ground and the wires buried a foot or so under the surface. The problem of keeping these grounds moist can be solved as follows: make a 4-inch tube of galvanized sheet iron, 12 x 42 inches, well perforated. Set it in a four-foot post hole, after soldering to the tube the rubber covered wire. Fill the center of the pipe with

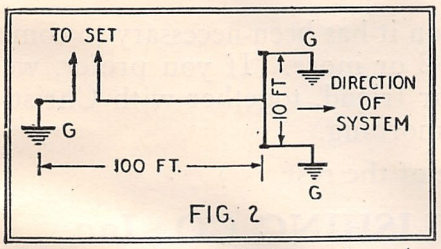


FIG. 2

Excellent results are obtained when the receiving system is grounded in three places, at the distances indicated.

LEARN RADIO

$75.00 A WEEK
BUILDING RADIO SETS
—*in your spare time*

Join the Radio Association of America. Learn how to build and repair radio sets. The Association will train you—start you out in business if you wish. Be the radio "doctor" of your community. $3 an hour upwards easily made. Radio offers you a big money-making opportunity right now.

EARNS $500 IN SPARE HOURS

"I have at last found myself," writes Lyle Follick, Lansing, Michigan, "I have already made over $500 building radio sets after working hours." Werner Eichler, Rochester, N. Y., writes, "I have made over $50 a week in my spare time."

Our members are starting radio stores, increasing their salaries, securing better positions, passing radio operator examinations, earning big money for the most enjoyable kind of spare-time work.

WHAT A MEMBERSHIP MEANS

A membership in the radio Association of America gives you the most up-to-date and thorough training in the Science of Radio.

You're taught how to build and repair all kinds of sets. You're given the training you need in preparing for a Licensed Radio Operator's examination. You receive the privilege of buying parts at wholesale prices.

You're helped to make money.

JOIN THE ASSOCIATION NOW

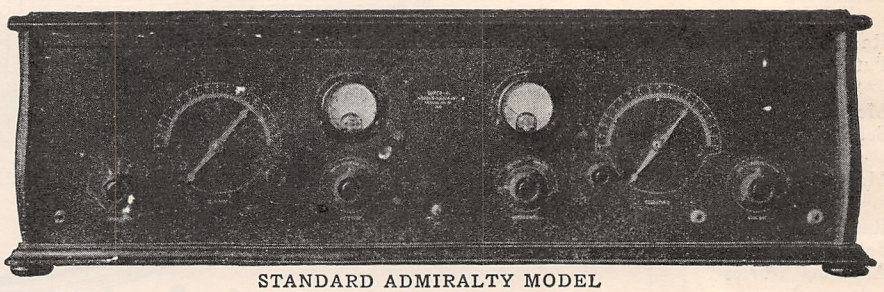
If you're interested in Radio for either pleasure or profit, join the Association without delay, because we have a plan whereby your membership may not—need not—cost you a cent. Only a limited number of these memberships are acceptable. Write now for details. Write before it's too late.

This Association has prepared a beautiful book that gives figure-facts regarding the profit possibilities of the Radio Industry, the purpose of the Association, and the details of the Special Membership Plan.

MAIL THIS COUPON

RADIO ASSOCIATION OF AMERICA
Dept. 1512—4513 Ravenswood Ave., Chicago
Send me your book and details of your Special Membership Plan.

Name .....
Address .....
City ..... State.....



STANDARD ADMIRALTY MODEL

Norden-Hauck Super-10
Highest Class Receiver in the World

The Norden-Hauck Super-10 is an entirely new and advanced design of Receiver representing what we believe to be the finest expression of Modern Radio Research Engineering in point of extreme range, with tremendous audibility, quality of reproduction Broadcast Receiver that can be built today. Wave length range adaptable 35 meters to 3600 meters with removable coils.

Mail the attached coupon today and we will tell you of a host of features that place the Norden-Hauck Super-10 far in advance of competition.

Write, Telegraph or Cable Direct to

NORDEN-HAUCK, Inc.
Engineers
Marine Building, Philadelphia, Pa., U. S. A.
Cable Address NORHAUCK

NORDEN-HAUCK, Inc.
Philadelphia, U. S. A.

Gentlemen:—

☐ Please send me without cost or obligation on my part, attractive illustrated literature describing the new Norden-Hauck Super-10.

☐ I enclose $2.00 for which please send me, postpaid, complete full size constructional drawings and all data for building the Super-10.

Name.....

Address.....

PARTS IN STOCK FOR THE NEW HAMMARLUND-ROBERTS "Hi-Q" Receiver

3-17 Pl. .00035 mfd. Hammarlund Midline Condensers	at $4.75	$14.25
3 Hammarlund Auto-Couple Coils, (set of 3 coils)	10.00	10.00
1-9 Pl. 32 mmfd. Hammarlund Jr. Condenser	1.80	1.80
1-Foundation Unit	10.50	10.50
2-Samson Audio Transformers, type HW-A3 (3-1 ratio)	at 5.00	10.00
2-Martin Copeland 192 Vernier Dials	at 2.50	5.00
2-Radiall 1-A Amperite	at 1.10	2.20
1-Radiall 112 Amperite	1.10	1.10
3-Benjamin No. 9040 Sockets (with bases)	at $.75	$2.25
2-Benjamin No. 9049 Sockets (without bases)		$.50 $1.00
1-Lynch 2 Meg. Metallized Resistor	at .50	.50
10 Eby Engraved binding posts	at .15	1.50
1 Sangamo .00025 mfd. Fixed Condenser	at .40	.40
1 Sangamo .001 mfd. Fixed Condenser	.50	.50
1 Sangamo pr. Grid-Leak clips	.10	.10
1 Carter No. M-10-S Combined Rheostat & Filament Switch (10 ohm)	at 1.00	1.00
1 Carter No. 1 "Short" Jack	.25	.25
1 Carter No. 12 "Imp" Aerial Switch	.70	.70

Complete Parts $63.05

We also have complete parts for the New Henry-Lyford Plug-in coil receiver, $69.50.

We carry standard parts for all circuits, packed and ready to ship.

DEALERS WRITE FOR NEW CIRCULAR.

Wholesale **HEINS & BOLET, 44 PARK PLACE, NEW YORK** **Retail**

A Christmas gift that lasts the whole year through—

Choose from this list. Use coupon below and order by Group Number. Subscriptions sold only in groups shown.

A		
1 Money Making 2 Radio News	}	$4.25
B		
1 Science & Invention 2 Boy's Life	}	3.75
C		
1 Amaging Stories 2 Science & Invention	}	4.25
D		
1 Radio News 2 Collier's Weekly	}	3.75
E		
1 Science & Invention 2 World's Work	}	5.50
F		
1 Amazing Stories 2 American Magazine 3 Woman's Home Companion	}	5.00
G		
1 Money Making 2 Pathfinder	}	2.75
H		
1 Radio News 2 Pathfinder	}	2.75
I		
1 McCalls 2 Science & Invention or 3 Money Making	}	3.00
J		
1 Radio News 2 Science & Invention 3 Amazing Stories	}	6.00
K		
1 Amazing Stories 2 Money Making	}	4.25
L		
1 Cosmopolitan 2 Good Housekeeping 3 Radio News or 4 Science & Invention	}	6.25
M		
1 Pictorial Review 2 McCalls 3 Money Making or 4 Amazing Stories	}	4.00
N		
1 Radio News 2 Science & Invention 3 Amazing Stories 4 Money Making	}	8.00
O		
1 Radio News 2 Radio Review (quarterly)	}	3.50

—SPECIAL—

Your own subscription to either Science & Invention, Amazing Stories, Radio News or Money Making and a year for your friend of either of these magazines with a Christmas card to reach him on Christmas Day all for $4.00.

—and it's inexpensive too!

Here's a happy solution to your gift problem. Use the coupon below. We take care of the rest.

Not every day in the year can you offer such a genuine, agreeable surprise to your friend or friends.

As a special Christmas opportunity you can obtain a 12 months' subscription to any of the magazines shown on this page at greatly reduced rates.

In order to make possible this reduction it has been necessary to combine these magazines into groups of 2 or more. If you prefer, we will send one to you, the other to your friend, together with Christmas card to reach him on Christmas morning.

Just fill out the coupon—we take care of the rest.

EXPERIMENTER PUBLISHINC CO., Inc.
53 PARK PLACE, NEW YORK, N. Y.

EXPERIMENTER PUBLISHING CO., Inc., 53 Park Place, N. Y.

Gentlemen:—I enclose $.....for 12 months' subscription to magazines in Group.....Kindly send magazine Number.....in this group to my friend and magazine Number.....to myself.

Your Friend's Name ..... Your Name .....

Address ..... Address .....

City, State ..... City, State .....

NOTICE—Be sure to mention group letter, and the number of each magazine desired. Enclose full amount. Do not forget to write your friend's name and address.

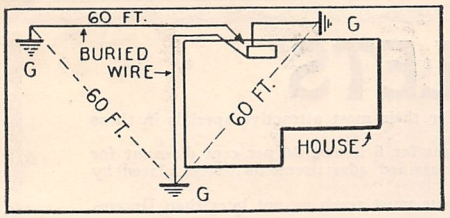


FIG. 3

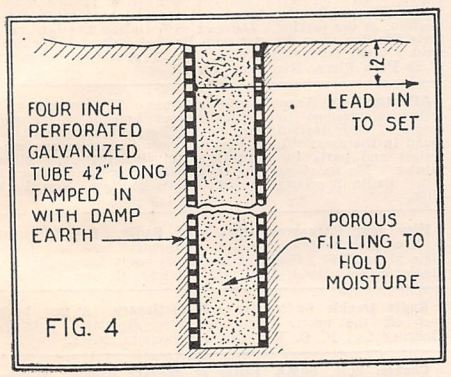
The three grounds triangularly spaced give better directional effects, and are easily located on a city lot of average size.

gravel, coarse sand, coke or other porous material, and tamp stiff mud around the outside of the tube. Be sure to set the top of the tube below the level of the ground so that a small depression can be left to collect surface water and lead it to the center of the tube. Thorough soaking occasionally will keep these grounds in good condition. It is a good plan to place them in flower beds, so that they will get watered when the beds are watered. (Fig. 4.)

With any set having controlled regeneration, volume equal to the best outside aerial can be secured with equal selectivity. Neutrodyne sets will give slightly less volume, but greater clarity. Low-loss regenerative, regenerative superheterodynes, counterphase, Browning-Drake and many other types of sets were tried with good results.

INTERFERENCE

Static, squealing sets and most electrical disturbances existing in a large city are greatly diminished. While noises due to de-



An excellent method is here shown for obtaining a good ground connection; which is a most important factor in this type of reception.

fective rail bonds on electric car tracks, defective ground wires on transformers and power houses are magnified, fortunately these disturbances are rather rare.

Short-wave stations are received regularly during the daytime, 2XAF on 32.79 meters and KDKA on about 63 meters coming in on the loud-speaker (in Los Angeles) with a regenerative detector and two stages of audio amplification. Broadcast reception in daytime is better than by regular aerial, but still shows the effect of daylight, suggesting that the waves must traverse some distance in the air before entering the ground. In other words, the station's radiation is from the aerial and not from the ground connection.

TRANSMISSION

In time we may expect underground radiation, possibly using the system just outlined for reception, and then we may look for DX reception by day or night. Such a system might eliminate the "skip distance" of the short-wave stations. It is the writer's hope that experiments will be made along these lines, for he believes that the future of radio will depend on underground transmission and reception

Send for Latest RADIO CATALOG and GUIDE

164 PAGES OF 1927 BARGAINS

The new 164-page 1927 edition of the **Barawik Builder's Guide** is now ready. This is the book that hundreds of thousands of radio enthusiasts turn to when they want the latest and best in radio at big discounts. It's a handy and most reliable radio reference guide. Keep up to date by utilizing Barawik service. It will help you to solve many a radio problem as well as saving you tremendous sums on the very things you need and use most. You want the latest—We have it—at bargain prices, too.

The new **Guide** is brimful of the best approved standard radio sets. parts and kits, at savings that will appeal to the thrifty. Profusely illustrated with reliable guaranteed goods at tremendous savings. Be sure to get your copy before you spend another cent for sets, parts and radio supplies.

VALUABLE INFORMATION FREE

Complete Parts for All the Newest Circuits

In every issue of RADIO NEWS and other radio magazines you will find the newest circuits of the world's greatest radio engineers. You will want to build these sets from the parts specified. BARAWIK service keeps up to date on all the new wrinkles. The new BARAWIK Guide is brimful of valuable information. We have the specified parts for all the new circuits, complete, ready to ship you the instant your order arrives. Take advantage of this unequalled service. Get what you want—quick—at a big saving. No order too large or too small for us. 300,000 fans thrive by using BARAWIK service. We can please you, too. Get your free copy of the complete 164-page Guide for 1927 NOW. Delay means loss to you.

Special Amateur Section—Short Wave Equipment

Another new Barawik idea is the **Amateur Section** under the direction of F. J. Marco, 9ZA, wherein is presented for the first time a complete line of short wave receivers, transmitters and all the necessary amateur equipment so dear to the amateur experimenter—all at bargain prices. Don't miss the opportunity to look into this inviting field.

Get Your Free Copy To-day—*NOW*

To everyone mailing the coupon or writing us a letter or postcard we will mail free the new 1927 Barawik Radio Guide, with its 164 pages of everything interesting for the Radio fan. Never in the history of radio has such a tremendous collection of radio supplies been presented to the public. Build the set of your dreams now. Get the things you have always longed for. You can do it, for our low prices will make the most expensive articles reasonable in price.

Mail Coupon Now. Get this Guide into your hands before you buy another part. It will mean money in your pocket. Write today; also please send names of other radio fans.

BARAWIK CO.

540-542A MONROE ST., CHICAGO, U. S. A.

NAME .....
ADDRESS .....
FRIEND .....

We have been making and selling Radio Cabinets for 4 years. To-day thousands of the boys know exactly where to buy good cabinets at a low price. FREE Catalogue

"IVEYLINE"—Sizes 7" x 18" to 7" x 30", 7½" or 10" deep. Mahogany rubbed finish or solid walnut. Full length piano hinge, lid support and rubber feet.

"PIEDMONT"—7" x 18" x 10", 7" x 21", 7" x 24", 7" x 26"—your choice, $2.65 each, f. o. b., Hickory. Mahogany rubbed finish, fancy nickeled hinges.

THE SOUTHERN TOY COMPANY, Inc., Hickory, North Carolina

Insure your copy reaching you each month. Subscribe to Radio News—$2.50 a year. Experimenter Publishing Co., 53 Park Place, New York City.

OPPORTUNITY AD-LETS

Follow these advertisements every month. Reliable advertisers from all over the country offer their most attractive specials in these columns.

Classified advertising rate twenty-two cents a word for each insertion. Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than 10 words accepted.

Objectionable or misleading advertisements not accepted. Advertisements for the February issue must reach us not later than December 1st.

CIRCULATION LARGER THAN THAT OF ANY OTHER RADIO PUBLICATION

EXPERIMENTER PUBLISHING CO., INC., 53 Park Place, New York, N. Y.

Agents Wanted

Big Money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 133, East Orange, N. J.

We Start You In Business, Furnishing everything. Men and Women, opportunity to earn $40.00 to $100.00 weekly operating Ragsdale's original "New System Specialty Candy Factories" anywhere; wholesale or retail. Valuable commercial candy book free. W. Hillyer Ragsdale, Drawer 210, East Orange, N. J.

Representatives wanted to sell guaranteed 180 volt "B POWER UNIT" for $25.00. Liberal Commissions. Exceptionally attractive agency proposition. George Electric Company, 754 Carlton Ave., St. Paul, Minn.

A permanent Position and Good Income is open to man or woman handling our goods in your locality. Established 35 years. No experience or capital. Full or part time. Dignified work. Write Employment Dept., Winter Company, 18 Winter Bldg., Washington, D. C.

Sure Seller to every merchant—no gamble—big profits—steady repeater—free sample and exclusive territory. Embossed Show Card Co., 1460 Euclid, Cleveland, Ohio.

Easy Sales—Quick Profits—dilute our concentrated materials for making high quality foods, beverages, extracts, toilet and auto specialties. Market under your brand or ours. Labels and containers furnished. Permanent, profitable, exclusive. D-B Concentrating Co., Station E-24, Kansas City, Mo.

Agents—Snappiest household line on earth. Red hot sellers, steady repeaters—100% profit. 350 light weight, fast selling, popular priced necessities. Selling outfit free. Get busy quick—Write today; postal will do. American Products Co., 6329 Monmouth, Cincinnati, O.

Business Opportunities

Free Book. Start little Mail Order Business, Pier Company, 72AF Cortland Street, N. Y.

Stocks—Bonds, Domestic—Foreign, bought—sold. Dealers in all marketable securities. Frank Y. Everett & Co., 20 Broad St., New York.

Manufacture Crystals—Big profits, particulars Free. Box 313, Wichita, Kansas.

Establish Your Own Industry. Start small, in spite of your handicaps, and grow successful. How? By becoming a co-operative EIA member. Prospectus and catalogues 25c. Equitable Industries Association, 154-R Nassau Street, New York.

Manufacture New Fast Selling Novelties, Toys, Preparations, Agent's Goods. Free list reliable plans, patterns, processes, commercial information. Manufacturer's Bureau, 1129P East 31st, Kansas City, Mo.

Publish a magazine of your own and start a mail order business on $1.00 capital. Sample magazine and details 25 cts. (coin). E. D. Tupper, P. O. Box 184, Los Gatos, Calif.

Chemistry

Learn Chemistry at Home. Dr. T. O'Conor Sloane, noted educator and scientific authority, will teach you. Our home study correspondence course fits you to take a position as chemist. See our full page ad on page 766 of this issue. Chemical Institute of New York, 66 W. Broadway, New York City.

Correspondence Courses

Used correspondence school courses. All kinds. Sold on repurchase basis. Big saving. Money back guarantee. Lists free. (Courses bought). Lee Mountain, Pisgah, Alabama.

Farms, Land, Etc.

Land Free if planted to bananas. Bananas bear a full crop the second year. $5.00 monthly will plant five acres, which should pay $1,500 profit annually. Reliable Companies will cultivate and market your bananas for 1/3. Bananas ripen every day and you get your check every 90 days. For particulars address National Development Co., Empire Building, Block 138, Pittsburgh, Pa.

For Advertisers

Advertisers International Manual, new edition. Inside information for advertisers and Publishers' Rates. 50c postpaid. Economies Publishing Co., Dept. 56, 1475 Broadway, New York.

Help Wanted

Detectives Needed Everywhere. Travel. Experience unnecessary. Write, George Wagner, former Government Detective, 1968 Broadway, N. Y.

Earn $25 weekly, spare time, writing for newspapers, magazines. Experience unnecessary. Details FREE. Press Syndicate, 973, St. Louis, Mo.

All men—women, 18-60, wanting to qualify for Permanent Government Positions, $140-$300 month, home or elsewhere. Write, Mr. Ozment, 251, St. Louis, Mo.

Home Study Courses

Used Correspondence School Courses and Educational Books, bought, sold, exchanged; Bargain Catalogue FREE. Hanfling, R-799 Broadway, New York.

Incorporations

Delaware Incorporator, Charters; Fees Small; forms. Chas. G. Guyer, 901 Orange St., Wilmington, Del.

Instruction

Learn Chemistry at Home. Dr. T. O'Conor Sloane noted educator and scientific authority, will teach you. Our home study correspondence course fits you to take a position as chemist. See our full page ad on page 766 of this issue. Chemical Institute of New York, 66 W. Broadway, New York

Miscellaneous

Multigraph typewritten letters sell anything. Two dollars thousand. Meyer Rey Corporation, Monmouth, Illinois.

W G Y's Home City; Twelve dandy views—Schenectady, N. Y., Post-paid 25 cents (coin). Patrick-Mahoney Co., P. O. Box 931, Schenectady, N. Y.

Grandfather clock works $5.00. Build your own case, instructions free; make good profits selling your friends. Clock works with chimes for old or new cases. Write for full particulars. Clock Co., Nicetown, Phila.

Lightning Electrolyte. Charges storage batteries instantly. Gallon costs 50c, sells $10.00. Make it yourself. Guaranteed formula $5.00. Write for free circulars. Murphy, Chemist, Tujunga, Calif. Box-D.

Motorcycles, Bicycles

Don't Buy a Bicycle Motor Attachment until you get our catalog and prices. Shaw Mfg. Co., Dept. 6, Galesburg, Kansas.

Old Coins

German Gov't Bond 5,000,000 Mk, 1924, $1.50. 2,000,000 Mk Bond 1923, $5.00. 500,000 Mk, Bill and Catalogue, 10c. Norman Shultz, Box 746, Salt Lake City, Utah.

Old Money Wanted

$2 to $500 each paid for hundreds of Old or Odd Coins. Keep all old money, it may be very valuable. Send 10c for New Illustrated Coin Value Book, 4x6. Guaranteed prices. Get posted. We pay Cash. Clarke Coin Company, 14 Street, LeRoy, N. Y.

Patent Attorneys

Inventors—Should write for our Free Guide Books and "Record of Invention Blank" before disclosing inventions. Send model or sketch of your invention for our Free Inspection and Instructions. Radio, Electrical, Chemical, Mechanical and Trademark experts. Terms reasonable. Victor J. Evans & Co., 922 Ninth, Washington, D. C.

Patent Attorneys (Continued)

Patents—Send for form "Evidence of Conception" to be signed and witnessed. Form, fee schedule, information free. Lancaster and Allwine. Registered Patent Attorneys in United States and Canada, 269 Ouray Bldg., Washington, D. C.

Patents. Send drawing or model for examination and report as to patentability. Advice and booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 644 G Street, N.W., Washington, D. C.

Patents

Inventions Commercialized. Patented or unpatented. Write Adam Fisher Mfg. Co., 278 Enright, St. Louis, Mo.

Patent Sense valuable book free. See Lacey's ad page 767 Lacey & Lacey, 631 F St., N.W., Washington, D. C.

Postage Stamps

Stamp Collectors—Phillips Monthly Bulletin (illustrated) offers over 2000 special bargains, sets, packets, single stamps etc., each issue. Free. Phillips, Box 1012, Hartford, Conn.

Radio

Boys! Don't Overlook This. The "Rasco" Baby Detector. Greatest detector ever brought out with molded base. Fully adjustable. See former advertisements in this publication, or our catalog. Detector with Galena Crystal, complete 50c, the same detector with Radiocite Crystal, 75c prepaid. Send for yours today. Radio Specialty Company, 96-98 Park Place, New York City.

Attention!—50 Vacuum tube hook-ups. The greatest collection of vacuum tube circuits ever brought under two covers at such insignificant cost. These diagrams will be found in the great "Rasco" catalog, which contains raw materials and parts in a greater profusion than any other catalog. 15c in stamps, or coin, will bring the catalog to you. Radio Specialty Co., 96-98 Park Place, New York City.

Play your Phonograph thru your Radio. Results equal to New Electric Phonographs. Inexpensive hook-up. Complete plans $1.00. Complete apparatus ready for use $17.50. Mogle & McClelland, Dept. B, Winfield, Kansas.

Radio trouble finder, log and dictionary. A new book just off the press. Send for free circular. Patrick-Mahoney Co., P. O. Box 931, Schenectady, N. Y.

Chokes. 50H, 60MA Filter or speaker bypass, $2.00—30H, 50MA, Raytheon Filer, $1.75—20H, 25MA $1.00, unmounted, Prepaid. Write for list of transformers, etc. Radio Parts Sales Co., Box 24, Orange, N. J.

Send 4 cents Stamps for Bargain Radio Catalog. Perryman 201A Guaranteed Tubes $1.60. Radio Specialty Shop, 525 Park Ave., Kent, Ohio.

Selenium- or Photo-Electric Cells. For all purposes, very sensitive, quick, and permanent in action. Three years guarantee. Send 10c stamps for catalog. Selenium Laboratories, Hampton Bays, Long Island, N. Y.

Build a Lifetime "B" Battery from my better Edison Elements. With Welded connections 7c pair. Sample cell 10c. Paul Mills, Woodburn, Oregon.

Single control Magnavox Radio $70. R. Schlegel, 1118 N. Negley, Pittsburgh, Pa.

Salesmen Wanted

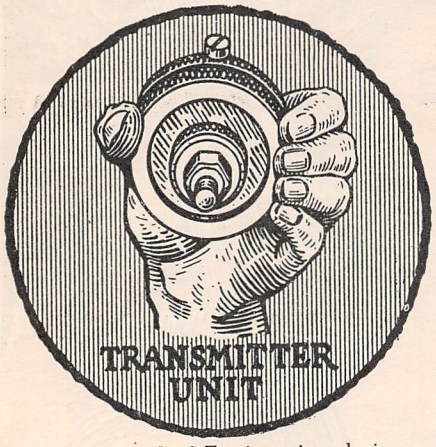
A Salesman wanted in every town or city within 25 miles of a broadcasting station to sell Radiogem, the complete radio receiving set that retails for $2.50. With Radiogem there is nothing else to buy—the outfit includes the Radiogem receiving apparatus, 1,000 ohm-phone, and aerial outfit. The cheapest radio outfit on the market—yet as practical as the most expensive. Big money to the right men. Send $2.00 for sample outfit. The Radiogem Corp., 66-R West Broadway, New York City.

Make $100 Weekly in spare time. Sell what the public wants—long distance radio receiving sets. Two sales weekly pays $100 profit. No big investment, no canvassing. Sharpe of Colorado made $955 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. OZARKA, INC., 431 N. LaSalle, Ave. K, Chicago.

Scenery for Rent

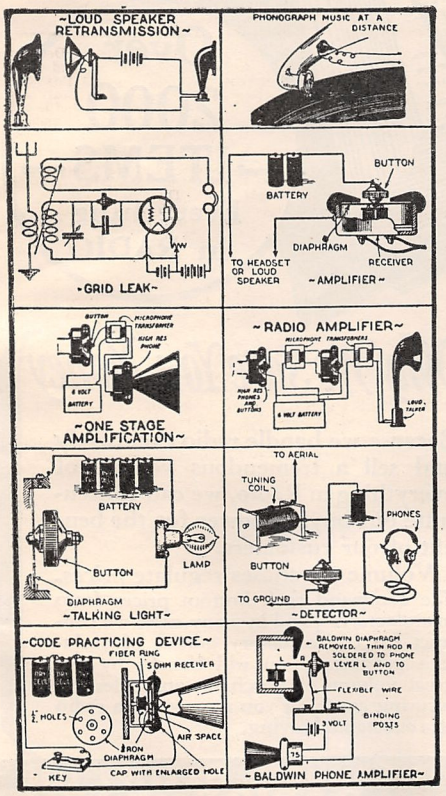
World's Most Beautiful Settings for operas, plays, minstrels. Amelia Grain, Philadelphia.

Thousands Use These Ingenious TRANSMITTER UNITS



Here's a marvel of Engineering design—a practical miniature transmitter, used by thousands of radio fans and experimenters for amplification purposes.
It is a most novel unit, having hundreds of uses. Every amateur should have two or three of these amplifiers in his laboratory.

A FEW USES FOR THESE UNITS



With each unit is mailed an eight-page instruction pamphlet containing suggestions for innumerable uses.
Our supply is limited; avoid disappointment by ordering today. The coupon below is for your special convenience.

SPECIALLY PRICED
While they last— **95c** per unit
(or Two for $1.75)

THE PRESS GUILD,
66-R West Broadway, New York, N. Y.
Enclosed find 95c/$1.75 for which send me postpaid one/two amplifier units as advertised.
Name .....
Address .....
City, State .....

School of Electricity

Electricity—Short day or evening courses in Electricity, Drafting, Engineering, and Architecture. In Chicago earn while you learn. Part Time positions pay expenses. Faculty of experts. Special short courses. Diplomas in 2 years. B.S. Degree in 3 years. Small classes, individual instruction. 23 year old institution with thousands of successful graduates. Enter any time. Employment bureau. Moderate tuition—monthly payments. New College building—all athletics. All details in 72 page "Blue Book." A copy will be sent to you free. Write today. Chicago Technical College, Dept. 27, 118 E. 26th St, Chicago, Ill.

Song Writers

Song-poem writers. Address Monarch, 1472 Broadway Dept. 122, New York.

Song Writing

Songwriters! Substantial Advance Royalty Payment essential to publication contract. Expert advice furnished beginners upon receiving poems requiring musical settings and copyright protection for free examination. Send today. Walter Newcomer, 1674 Broadway, New York.

Stammering

Stop Stammering, increase salary. Descriptive booklet free. Samuel Robbins, 399 Boylston St., Boston.

St-tut-t-t-tering and stammering cured at home. Instructive booklet free. Walter McDonnell, 121 Arcade, 1126 Granville Avenue, Chicago, Ill.

Telegraphy

Telegraphy—Both Morse and Wireless taught thoroughly. Big salaries. Wonderful opportunities. Expenses low, chance to earn part. School established fifty years. Catalog free. Dodge's Institute, Cour St., Valparaiso, Ind.

Wanted to Buy

Full Value Paid for Old Gold, Jewelry, Watches, Diamonds, crowns, bridges, dental gold, silver, platinum, gold or silver ore; magneto points, old false teeth. Packages returned if our offer is not satisfactory. United States Smelting Works (The Old Reliable) 39 So. State St., Dept. 16, Chicago, Ill.

RADIO BOOK AND PATTERNS

A complete list of famous Receivers, also information on all phases of Radio.

WRITE FOR BOOKLET

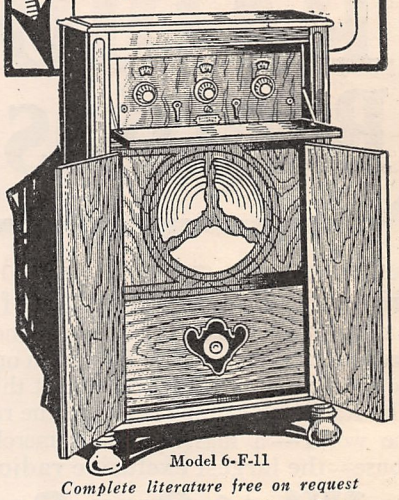
THE CONSRAD CO.,
53 Park Place, New York, N. Y.

The MASTERPIECE OF MASTERPIECES

New and Improved
FRESHMAN MASTERPIECE
$119.50

The most perfect radio ever designed. Massive—beautiful; just what you want for your home. No matter how exquisite your furnishings are this genuine mahogany upright Console will lend additional beauty.

Sold on easy terms by FRESHMAN Dealers



Model 6-F-11

Complete literature free on request

CHAS. FRESHMAN CO., INC.
Freshman Bldg. New York
2626 W. Washington Blvd., Chicago

3rd EDITION
"RADIO NEWS" *AMATEURS' HANDIBOOK*
so huge has been the demand

Here are a few of the features: Complete separate articles on constructing the following Receivers—Crystal Receiver, Radio News Laboratory (6 tube) Receiver, Single Control Regenerator, Roberts Circuit, Bell Wire Receiver, Autotransformer Receiver, 4 Tube-Dyadyne, Duodyne, Browning-Drake Regenaformer, Portable Receiver, Experimenter T.R.F. Set, the Infradyne, a Super Heterodyne, etc.

Also big articles on a three-foot cone speaker, latest model wave traps, Amplifier and "B" Supply unit, and many other features.

This is the finest edition of the Amateurs' Handibook ever issued—DON'T MISS IT!

116 Pages—size 9 x 12, Illustrated with Pictures and Diagrams.

NOW 50c EVERYWHERE

If Your Dealer Cannot Supply You Write Us Direct Enclosing 50c

Published by
EXPERIMENTER PUBLISHING CO., Inc.
53 Park Place - - - - - New York, N. Y.

FREE

This 84 Page Wonder Book of RADIO Bargains

Over 2000 —ITEMS— Everything in RADIO

Send for this guide to Radio prices and Radio quality. All of our vast resources and radio experience have been utilized to assemble for you in one gigantic institution, the best and newest things in radio. The Randolph catalog is indeed the radio market place of the world — a masterpiece of merchandising that befits our house—**the largest exclusive radio mail order house in the world.**

What Our Catalog Contains

Over 2,000 items—from the most beautiful, fully equipped console model radio set, down to the smallest part or tool for the set builder—kits, parts, and supplies of every conceivable type and style. All beautifully illustrated and interestingly described. And to give this book added value, we have included radio data that makes it an invaluable text book for every lover of today's most fascinating and most wonderful achievement—RADIO.

Radio Sets

In this great radio market place you will find table model sets and console types with built-in loud speakers; the newest ampliphonic console sets; new Spanish period consoles; **five, Six, seven, and eight tube sets.** with three dial, two dial, and the **newest and most popular single simplified control.** All sets are assembled in beautiful, genuine mahogany and walnut cabinets in a choice of latest types and designs.

5 Tube sets as low as $24.90
Latest 1927 Models

All Randolph sets are sold at amazingly low prices. No matter what kind of set you want—no matter how little you want to pay—you can select YOUR SET AT YOUR PRICE from the Randolph catalog.

Radio Kits

The radio kits we offer for sale are approved by the world's foremost radio engineers. Wonderful values in the latest kits, including all classes of radio frequency, super-heterodynes and every other approved popular and advertised circuit. There is nothing in the line of radio kits and parts of any value and which are in demand which we do not carry.

Radio Parts and Supplies

The Randolph catalog also contains a most complete line of **"B" Battery Eliminators, including the famous Raytheon Eliminators;** the latest type of Loud Speakers, Cone Speakers, a complete line of quality "A" power units — in fact, you will find listed in this wonder book every part that goes into the construction of a radio set, or any accessories you desire, at prices that mean a **substantial saving to you.**

Free Radio Service

Everyone has need for radio service. The average man has no time to keep up with the rapid developments of radio. We employ Radio Engineers who have made radio their life work. Their expert advice and helpful suggestions solve every radio problem of our customers.

Our Guarantee

Every article in our catalog is based on careful laboratory analyses and tests. We guarantee to back up every item in our catalog with our own as well as manufacturer's assurance of quality.

YOU MUST HAVE THIS BOOK

Space limitations here prevent our telling you more about the Randolph Catalog. Simply fill out and mail the coupon—or you may send a postal or letter—and this truly remarkable Radio book will come to you **ABSOLUTELY FREE. MAIL THE COUPON NOW.**

Randolph Radio Corporation

180 North Union Avenue • Dept. 181 • Chicago, Ill.

Why We Save You Money

Because we handle radio exclusively and sell a tremendous volume of everything in Radio, we can concentrate our buying power for the benefit of our customers.

Volume purchases regulate prices. We command rock bottom prices from manufacturers, and in many cases we contract for entire factory output of exclusive products. You will benefit by our great volume of purchases and sales, by securing anything you may want in radio at a substantial saving.

This Coupon Brings the Great RADIO Book FREE

RANDOLPH RADIO CORPORATION
180 N. Union Ave., Dept. **181**
Chicago, Illinois

Send me—free—your 84-page, 1927 Radio Book.

*Name*_____

*Street and No.*_____

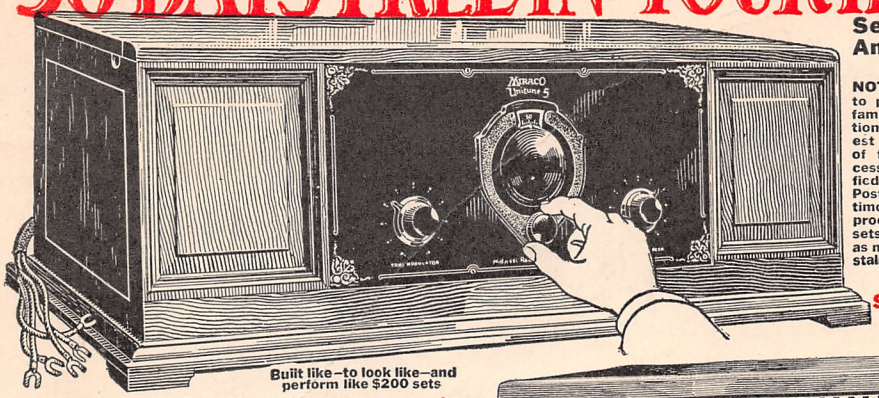
*R. F. D.*_____ *Box*_____

*City*_____ *State*_____

PRINTED BY GILES PRINTING CO., LONG ISLAND CITY

30 DAYS FREE IN YOUR HOME

Tested and approved by all of Radio's Highest Authorities



Built like—to look like—and perform like $200 sets

Send Coupon for Amazing Special Offer!

NOTE: This offer is made to prospective buyers by famous big Radio Corporation, one of America's oldest reliable manufacturers of fine sets—seventh successful year. Many satisfied users in every state. Postal or coupon brings testimony of nearby users and proof Miraco's outperform sets costing up to 4 times as much. Very easy to install and operate.

AMAZING SPECIAL OFFER to User-Agents who will allow friends to listen to their Miracos.

BEAUTIFUL-BIG-POWERFUL Ultra Selective MIRACO Ultra 5

Retail LIST Price $49.75 now only

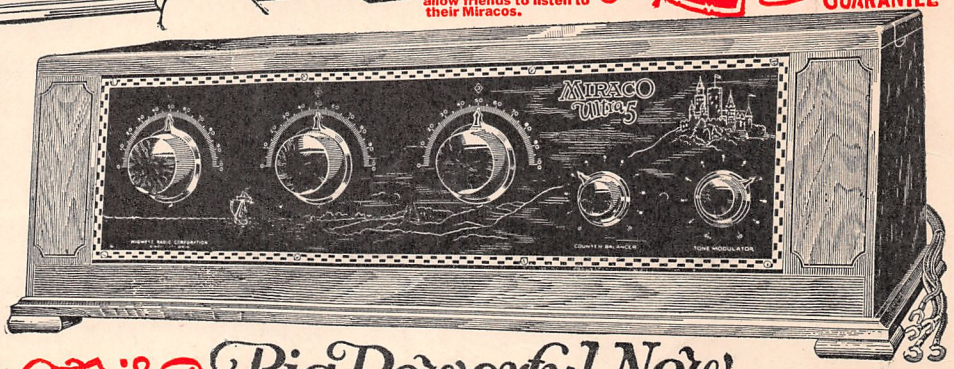
GET SPECIAL OFFER

One year GUARANTEE

Real Single Dial Control!

Magnificent Big Powerful Miraco "Unitune-5" Get Special Offer and Amazing Low Price!

The celebrated Miraco Ultra-5—U.S. Navy type circuit, has also been adapted to Single Dial Tuning—**without sacrifice of selectivity, volume, clearness, power, tone, or distance getting qualities!** In the magnificent big Miraco Unitune-5, above shown, you turn one vernier knob for stations everywhere. Beautiful hand-rubbed, piano hinged, solid walnut cabinet, 28 in. long, 15 in. deep, 10 in. high. Sloping Bakelite panel is walnut finished to match. Also **offered on 30 days free trial!**



Coast to Coast and Foreign Reception Certified by Miraco users

MIRACO RADIO GETS 'EM COAST TO COAST

Send for Proof!

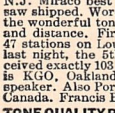
Notice! Enormous sales of the celebrated Miraco big fine Receivers (resulting from delighted users so highly endorsing them to friends) again enable us to add hosts of costly new features, latest refinements and up-to-the-minute improvements such as you might expect to find only on much higher priced sets. Miraco's this year are still better—more beautiful—more selective—more powerful for less money than ever before.

USER-AGENTS WANTED . . WRITE!

Reports from users everywhere leave little for us to add. These are only a few of the many in our files and which we receive daily. Send coupon for plenty of additional proof and testimony of nearby users.

HAS NO EQUAL FOR TONE, VOLUME, DISTANCE. North Wildwood, N.J. Miraco best packed set I ever saw shipped. Words cannot express the wonderful tone quality volume, and distance. First night received 47 stations on Loudspeaker. Up to last night, the 5th day, I have received exactly 103 stations; farthest is KAO, Oakland, Calif. on loudspeaker. Also Porto Rico, Cuba and Canada. Francis B. Lee.

TONE QUALITY PLEASES EVERYONE. Philadelphia, Pa. Everyone that hears the Miraco is very pleased with tone, distance, etc. I tuned in during International Test Week; KGO, Oakland, Calif.; CYB, Mexico City, Mex.; 6KW, Cuba; 2EH, Edinburgh, Scot.; also a station in Buenos Aires, Argentine. Geo. W. Hill, Jr.



WISCONSIN HEARS COAST TO COAST. Racine, Wisc. I got station 2LO London last Wednesday night on my Miraco. Heard a chair rising and announcement. Have also heard PWX, Havana, Cuba; CYZ, Mexico City and 104 American stations from coast to coast. Lawrence Risberg.

SELECTIVITY!--CUTS THROUGH STRONG LOCALS. Detroit, Mich. I am more than satisfied with my Miraco. I can cut through WWJ, WCX, WJR, WGHP, very strong local stations, and this is done with quarter of a turn. In every way it is simply perfect. Charles Paul.

UTAH ENJOYS COAST TO COAST PROGRAMS. Heber City, Utah. The Miraco sure can't be beat at any price. Coast to coast it sure does and more. I have had stations in New York and Cuba in the east, and scores of other stations on the west coast. I have logged up to date 150 stations and they all come in wonderfully. Monte Giles.

MIRACO WINS AGAINST 3 OTHER MAKES. Pearland, Texas. I tried three other makes and the Miraco is the best of them all. Received KFI, Los Angeles, Calif. on loudspeaker. O. H. Richards.

Nacogdoches, Texas. On my Miraco I have heard stations from Cuba to San Francisco and from Mexico City to Pittsburgh. Walter M. Frisbie.

COAST TO COAST LOUD AND CLEAR. Guthrie, Minn. We logged over 30 stations and got over 1500 miles on the loud speaker the first night--our first experience tuning a radio. The third night we got WJAX Jacksonville, Florida and KFI Los Angeles, Calif., on the loudspeaker. Neighbors say Miraco is the best they have ever heard. O. R. Wolf.

MIRACO BEATS A SUPER EIGHT. Cobalt, Ontario, Canada. Miraco is one of the best radios in all the north country. There is a man here who has a big Super eight and our Miraco beat it. W. Saumier

OUTPERFORMS SOME $300 SETS. Blakely, Ga. I am well pleased with my Miraco. It does better than machines that cost $200 or more. J. D. Tison.

MOST SELECTIVE-SUPERIOR TO $120.00 SET. Santa Cruz, California. I do not hesitate to show my friends the "Miraco Superiority" over my (names another set) costing $120.00. The Miraco is the most selective set I have seen yet and cuts out the jumble of stations on the low wave lengths in 1 1/2 points. Wm. Schuette.

MELLOW TONE -- LOUD AND CLEAR. Indian River City, Fla. A wonder set. Am having splendid results. Have had Miraco four nights and have stations on my list from Cuba to New York, Chicago, Denver, Texas, all coming in loud, mellow in tone and clear. I have one sold already and did not even try. Mr. H. G. Duff.

REFUSED TO TRADE IT FOR EXPENSIVE SET. Prosper, Ore., Over 31 stations brought in first night on loud speaker. I ordered the Miraco for a friend and he is more than pleased. I offered to trade my Neutrodyne for it but he refused and it has the name of the best set in the community. M. E. Hulton.

PENNSYLVANIA BEGINNER GETS 'EM ALL OVER. Corry, Pa. Have had Miraco one month today and have received over 115 stations from all parts of the United States, Canada, Cuba and Mexico. I think this is pretty good for one that never had any experience before. Clarence Drugfelder.

LIKES IT BETTER THAN $150 --$250 SETS. Westville, Ill. Miraco sure is a wonderful set. I get the stations easily without noise--that's one of the things I like about the Miraco. I've had three other sets that have ranged from $150 to $250 each but Miraco beats them all. My friends all like the Miraco. I have had stations all over the U.S.A. I tune in Mexico City and Havana, Cuba any time they are on the air. Alex Kinder.

BEATS COSTLIER SETS WITH MORE TUBES. Lexington, O. I have given Miraco a thorough try out and find it to do all you claim. 85 stations logged so far; getting new ones every week. This list includes coast to coast, Canadian, Cuban and Mexican stations. The **selectivity is remarkable.** Others here in town have more expensive and elaborate sets with more tubes but do not ever do this. Fuller Temple.

MIRACO OUTPERFORMS THEM ALL. St. Francis, Kansas. I've heard a lot of radios but the Miraco is best all around. I am proud of mine. Comes in fine and clear. No noises. Get lots of distant stations. Surely am satisfied. Orvey Sharpe.

Send coupon for Amazing Special Offer.

Big Powerful New MIRACO Ultra 5

Solid Walnut Cabinet — Unitune 5 — 28 in. long

Solid Walnut Cabinet — 27 in. long

TRADE MARK REGISTERED

ULTRA-SELECTIVE LONG DISTANCE 5 TUBE SETS EASY ON BATTERIES

Unless Trial Proves Your Miraco the Most Selective, Clearest Toned, and Most Powerful Distance Getter—Don't Buy it!

No need to wear out expensive batteries burning 6, 7 or 8 tubes when users everywhere are reporting that the big latest Miraco 5-tube sets actually are *unsurpassed* (even at much higher prices) for razor-edge selectivity, extreme long distance reception, clear natural tone and powerful loud speaker volume combined with great economy in use of battery current! Enjoy a powerful Miraco 30 days in your home *—at our risk—*and be convinced! Your verdict final—absolutely no strings to this. *Save or make a lot of money* on sets and accessories this season by sending **IMMEDIATELY** for our *Amazing Special Offer!*

Deal Direct with a Big Reliable Corporation

Remember this offer is made direct to you by a big responsible manufacturing corporation—one of the oldest and most successful set-builders in the industry—a concern which has grown to immense size thru recommendations of its many thousands of satisfied customers who bought after trial.

Our Factory Prices Save You Up to One-Half

We deal direct by mail with users, agents and dealers, thereby effecting great savings which are reflected in amazingly low prices. *Everything we sell is high-grade. Don't confuse Miraco's with small, cheap sets.*

You'll be Proud of Your Miraco

In its big, handsome, expensive-looking solid walnut cabinet with sloping front, you'll be proud to have friends examine and hear your Miraco. In construction, appearance and performance, every inch a high-priced set. Handsomely gold illustrated genuine Bakelite front panel and genuine Bakelite knobs—finished in grained walnut. Finest parts obtainable—the kind used in $200 sets. Bakelite sub-panel. *Many exclusive features.* Each Miraco reaches you completely assembled, rigidly tested, splendidly packed and factory guaranteed for one year. Easy to install and operate—full instructions supplied. Send NOW for testimony of nearby users and *Amazing Offer!*

What a $3,000,000 Federal Reserve Bank Says:

"For years the Midwest Radio Corporation of this city have been very satisfactory customers of this Bank, one of the largest in Southern Ohio. The Midwest organization was one of the very first to engage in the manufacture of radio sets, and to us their success is evidenced by the sound and steady expansion of their business which we have observed year after year. We are personally acquainted with all officers of the Corporation and from experiences know them to be men of honor, integrity and ability. We consider them to be both morally and financially responsible. **They have a reputation for fair and square dealings."** THE PROVIDENT SAVINGS BANK & TRUST CO. Member Federal Reserve System. Capital and Surplus over $3,000,000.

AGENTS! DEALERS! Write for our latest Miraco proposition. Nation-wide popularity, superior performance of Miraco Radio sets, at amazingly lower prices, make them easy to sell. Send coupon today for proof

Midwest Radio Corporation — Pioneer Set Builders 7th Successful Year — Cincinnati, O.

All the Proof you want is waiting for You!

Coupon or postal brings reports from hosts of users in your vicinity and elsewhere proving that Miraco sets **at rock-bottom money-saving factory prices,** outperform sets costing up to four times as much. **You can also buy speakers, tubes, batteries, etc., at big savings from us!** Get our proposition before spending money elsewhere

MIDWEST RADIO CORPORATION
Pioneer Builders of Sets
Cincinnati, O.

404-R Miraco Building

Without obligation, send free literature, testimony of users, AMAZING SPECIAL OFFER and full particulars of your **big money-saving factory-price proposition** on Guaranteed Miraco sets and all radio supplies. ( ) Agent ( ) User ( ) Dealer

NAME

ADDRESS

many times better than in 1921

WITH four times less drain on your "A" batteries than the storage battery tube of five years ago, the filament of a Radiotron UX-201-A throws across to the plate five times as many electrons—a steady stream of tiny electrical charges that carry the song and speech. This is a big increase in efficiency!

And the Radiotron UX-201-A does not burn out—unless you apply a huge, excessive voltage. It does not die gradually, but keeps its efficiency almost to the very end of its life.

These are but a few of the advances in vacuum tube making that have come from the laboratories of RCA and its associates—General Electric and Westinghouse. Unceasing research brings continual improvement in RCA Radiotrons, making possible ever better reception—at lowered cost.

RADIO CORPORATION OF AMERICA

New York Chicago
San Francisco

to get more power

—put an RCA power Radiotron UX-120, UX-171 or UX-210 in the last audio stage of your set.

to get more distance

(on a storage battery set)

—put the new special detector Radiotron UX-200-A in the detector socket.

. . .

RCA is not only making Radiotrons steadily better—but is further improving reception with these new special Radiotrons. Keep your set up to date.

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA